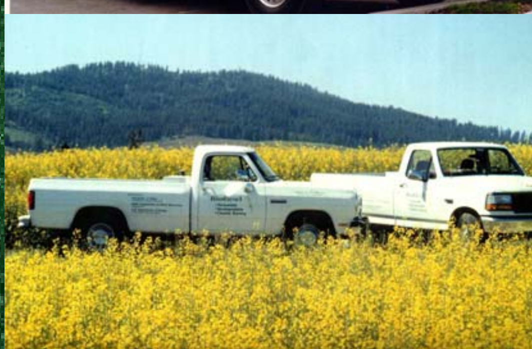
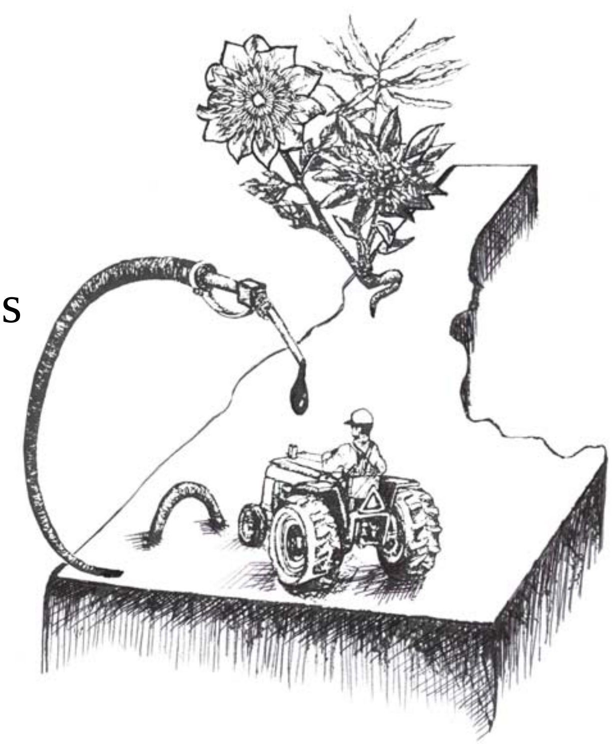


Feasibility Study for the Commercial Production of Biodiesel in the Magic Valley of Idaho



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Feasibility Study for Commercial Production of Biodiesel in the Magic Valley of Idaho

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I. EXECUTIVE SUMMARY

This study investigates the feasibility of a commercial biodiesel production plant in the Magic Valley using local resources. "The Magic Valley" as defined in this report is the eight counties: Blaine, Camas, Cassia, Gooding, Jerome, Lincoln, Minidoka and Twin Falls counties of Idaho (Figure 1). In 2006 the total population of the study area was estimated at 170,617. The growth rate in Blaine, Camas, Lincoln, Gooding, Twin Falls and Jerome counties has increased from 16 to 24 percent in the last ten years while there was only a small increase in population in Cassia County and an actual decline in Minidoka County. About 12% of Idaho's population resides within the study area. The study area comprises just over 7.4 million acres, of which 1.36 million acres, or 18%, are cropland.

Figure 1 – The "Magic Valley" Study Area

The purpose of the study is to identify potential local sources of raw materials for a biodiesel facility, suggest possible sites, and identify marketing options for the fuel produced and for all the potential by-products. In addition, the study identifies economic and environmental barriers affecting the location of a successful plant for the production of biodiesel.

There are several feedstocks and potential feedstocks from which to produce biodiesel in the Magic Valley. These include yellow grease, tallow, oils from food processing facilities, and oil from oil seed crops. Oil seed crops have been grown in the area on a limited basis. Safflower and sunflower are grown in the arid west from the central plains to California. Yield for all oil seed is related to available moisture. The response is about 100 to 150 pounds per acre per inch of available moisture for safflower and sunflowers, respectively. The local experience with sunflowers indicates that birds will greatly reduce yields. Safflower will grow as both a dry land and irrigated crop with returns equal to or greater than that for small grains. Rapeseed (canola and non-edible Brassicas) and mustard have been grown in many areas in Idaho, most notably the Palouse and the Camas Prairie north of Grangeville. However, there is a lack of crop and farm management information in the Magic Valley to optimize the incorporation of any oil seed crops in the rotation.

Resources exist to develop a small to medium sized biodiesel facility and a corresponding market in the Magic Valley. Site location will be influenced by plant size. Mid-sized to large plants would have to locate near existing rail lines. Small plants would use highways for both shipping in raw materials and shipping out products. Considering 50 percent of the available yellow grease as the only feedstock, a 470,000-gallon per year biodiesel plant could be supported. If both 50 percent of the yellow grease and tallow were feedstocks, then the capacity would increase to 4,570,000 million gallons.

Oil for a biodiesel plant can be brought in by rail from other areas. With current market prices for oil the feasibility of using this approach is attractive, particularly for starting up the plant. Using oil brought in by rail from other areas does pose a considerable risk since the supply is expected to rapidly dwindle with the nationwide interest in biodiesel.

Four scenarios were developed to examine the feasibility of using oil seeds grown in the area as feedstocks. Oil seed crops would have to compete with small grains in the rotation to be economically viable. It was estimated that 10 to 20 percent of the harvested cropland in the study area could be converted to seed crops. This equates to about 107,500 to 215,000 acres and represents 30-60 percent of the acres of small grains. There is also limited information on success of growing seed crops in the study area. The state average yield for seed crops in the state is about 1,500 pounds per acre. Most of this is grown on dryland farms. The study area is mostly irrigated. With irrigation it was estimated that yield could be improved to about 2,500 pounds per acre. Using the lower yield with the estimated range of available acreage would result in a 7.7 to 12.9 million gallon per year capacity. Using the more optimistic estimate of available acreage the crops could support a 15.5 to 25.8 million gallon per year biodiesel plant.

Thus, the potential exists in the Magic Valley for a mixed feedstock biodiesel plant with an annual capacity between 12.3 to 27.3 million gallons. The Magic Valley market for a B5 (5%) biodiesel blend is about 3 million gallons per year. A B20 blend would require about 12 million gallons per year.

The cost of biodiesel production is dependent on the plant capacity and feedstock selection. Feedstock is by far the big issue regarding the feasibility of a commercial biodiesel plant. The biodiesel production byproducts would be glycerin from all feedstocks and oil seed meal from oil seeds. Glycerin could be problematic for biodiesel plants in the Magic Valley even though it is used in many products and processes. It is costly to purify and impure glycerin has little value. In contrast, oil seed meal could be a component in the rations of dairy and beef cattle in the area of which there are sufficient number to utilize both byproducts.

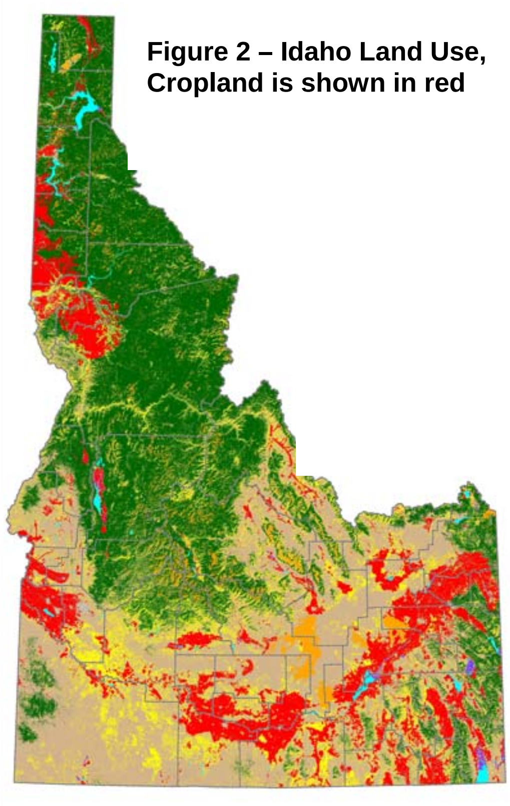


Figure 2 – Idaho Land Use, Cropland is shown in red

II. INTRODUCTION

Biodiesel has exploded into one of the most exciting segments of the energy arenas. From national energy security strategies to environmental protection to an engine for economic development, biodiesel now combines all these and other critical elements to make it a front burner issue in the United States and many other countries.

Biodiesel is a product made from vegetable oil or animal fat that can be used as a replacement for diesel fuel in diesel powered vehicles. The process is a chemical reaction involving alcohol, such as methanol or ethanol, into which is added a catalyst such as sodium hydroxide or potassium hydroxide. This mixture is blended into the vegetable oil causing a chemical reaction, called transesterification, which separates the vegetable oil into two components. One component is a heavier liquid called glycerol (also called glycerin). Glycerol has many food and industrial uses however, glycerol from biodiesel production requires purification before it could be used for these purposes. The second component is called an ester of the oil or biodiesel.

What is Biodiesel?

An alternative fuel made from renewable resources such as

- ⇒ **Vegetable Oils (soy, corn, canola, mustard, etc)**
- ⇒ **Animal Fats (tallow, lard, etc)**
- ⇒ **Recycled Cooking Greases (grease, cooking oil, etc)**

Biodiesel can be used in pure form or blended with petroleum diesel at any level.

The purpose of the study was to identify potential local sources of raw materials needed for such a facility, suggest possible sites for a plant, identify marketing options for the fuel produced and for all the potential by-products, and consider alternatives for biodiesel production. The study was to also identify economic and environmental barriers to the location of a successful plant for the production of biodiesel.

For purposes of this study, "The Magic Valley" is defined as eight counties including Blaine, Camas, Cassia, Gooding, Jerome, Lincoln, Minidoka and Twin Falls (Figure 2). Total land area of the Magic Valley is just over 7.4 million acres. Of that 1.37, or about 18%, are in cropland that is mostly irrigated. The Magic Valley is one of the most productive cropping areas in the nation. Major crops include spring and winter wheat, barley, oats, alfalfa, corn for silage and grain, sweet corn, sugar beets, potatoes, and dry beans.

The study only considers available feedstocks and markets within the eight county area. Feedstocks outside the area could be used in a Magic Valley biodiesel plant, however those plants might be preempted by a biodiesel plant in the area where the feedstock came from. Biodiesel fuel and byproduct markets outside the study area would be in competition with other biodiesel producers.

The Magic Valley area is home to approximately 170,00 people. Twin Falls is the region's largest city and metropolitan area. Burley is the principal city of the region's other metropolitan area. The College of Southern Idaho (CSI) in Twin Falls is the Magic Valley's only college. Other important cities include Jerome, Rupert, Gooding and Hailey. An estimated 12% of the total population of Idaho resides within the study area.

There are an estimated 160,000 motor vehicles in the area of which less than 10% are diesel. There is an estimated on-road diesel use of about 29 million gallons and 59 million gallons of total diesel use per year.

Figure 3 – The “Magic Valley” Study Area

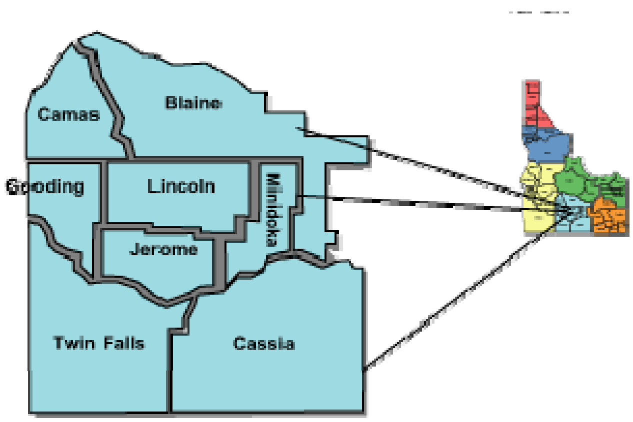


Table 1 - Study Area Population by County

COUNTY	POPULATION
Blaine	21,166
Camas	1,050
Cassia	21,324
Gooding	14,461
Jerome	19,638
Lincoln	4,545
Minidoka	19,014
Twin Falls	69,419
Total	**170,617**

From the U.S. Census Bureau 2005

The name "Magic Valley" is a reference to the construction of a series of irrigation canal systems on the Snake River during the first decade of the 20th Century. In a short time these projects "magically" transformed what had been considered a nearly uninhabitable area into some of the most productive farmland in the northwestern United States. Many cities and towns in the region were founded between 1900 and 1910 as a direct result of these projects.

Popular leisure activities in the Magic Valley include camping, hunting and fishing. Skiing at several resorts throughout the region is one of the most popular winter activities. Jackpot, Nevada, which is closely associated with the Magic Valley region, offers casino gaming. The Magic Valley is home to the famous Sun Valley resort in Blaine County. Other notable areas include City of Rocks, Pomerelle Ski Resort, Shoshone Ice Caves, Thousand Springs, Shoshone Falls and Perrine Bridge over the Snake River. The Magic Valley is the number one trout producing area in the United States and has the largest concentration of dairy production in the state. Important agricultural commodities in the Magic Valley include beans, sugar beets, corn (maize) and potatoes. Dairy production is also significant, especially in Jerome and Gooding Counties.

III. BIODIESEL PRODUCTION

Biodiesel is a product made from vegetable oil or animal fat that can be used as a replacement for diesel fuel in diesel powered vehicles. The process is a chemical reaction involving alcohol, such as methanol or ethanol, into which is added a catalyst, such as sodium or potassium hydroxide. This mixture is blended into the vegetable oil causing a chemical reaction, called transesterification, which separates the vegetable oil into two components. One component is a heavier liquid called glycerol (also called glycerin). Glycerol has many food and industrial uses, such as cosmetics, toothpaste, pharmaceuticals, foodstuffs, plastics, explosives, and cellulose processing to name a few. However, the material obtained from biodiesel production requires purification before it could be used for these purposes.

The second component is called an ester of the oil or biodiesel. The ester is lighter than the glycerol and so rises to the top after the reaction is complete. The ester, after carefully processing to remove all remaining catalyst, alcohol and glycerol, can be used as a fuel in diesel engines. The esters are good solvents, cleaning agents, and also used in cosmetics. They have been used to prevent asphalt from sticking to metal such as truck beds, and are used as surfactants in agricultural chemicals. They are lubricants and have other similar uses.

Feedstock

The first step in the production of biodiesel is obtaining a suitable vegetable oil or animal fat (feedstock). The sources are 1) collection of used oil commonly called yellow grease from delis, fast food restaurants, or processors, 2) collection of tallow from slaughter houses and packing sheds, 3) purchasing yellow grease or tallow from an existing renderer, 4) contracting production of vegetable oil seeds from local farmers, 5) purchasing clean seed from an existing warehouse or seedsman, or 6) purchasing vegetable oil from an existing crushing or expelling plant.

The availability of feedstock sources in the Magic Valley is discussed in the following chapter. Although yellow grease and tallow are available, there is a limited supply, existing markets, and generally make it more difficult to produce a quality fuel than biodiesel produced from virgin oils. Since there are currently no commercial seed crushing plants in Idaho, plants using virgin oil would need to either purchase and transport oil from outside the state or build a seed processing facility. While an assessment of developing a crushing plant is beyond the scope of this study, that operation may be more costly and larger in scope than the biodiesel production plant.

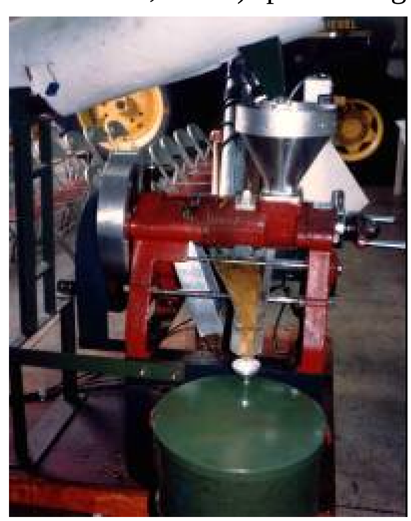


Figure 4 – Seed Crusher at the University of Idaho

Biodiesel Processing and Plant Design

The technologies utilized to produce biodiesel from the variety of potential feedstocks vary from simple to complex. Since the commercial production of biodiesel is a new industry the trend for plants currently operating or under development is that each facility uses its own proprietary process. It is likely that as the industry matures processes will become more standardized and efficient. The ultimate goal of whatever process is selected is to produce a biodiesel at minimum cost that meets ASTM specifications.

Currently the method most commonly used is the base catalyzed esterification with methanol, generally referred to as the methyl ester process. Essentially it consists of dissolving a catalyst such as potassium hydroxide or sodium hydroxide into the methanol and stirring this mixture into a tank of vegetable oil or animal fat. In some processes the reaction is completed at room temperature but more commonly the mix of oil and catalyst is kept just above the boiling point of the alcohol to speed up the reaction. Reaction time varies from one to eight hours. Excess alcohol, typically 100 percent excess, is used to ensure total conversion of the fat or oil to its esters. After the separation of the ester from the glycerol, excess alcohol is removed by evaporation. The following is the most basic recipe that is used for producing biodiesel.

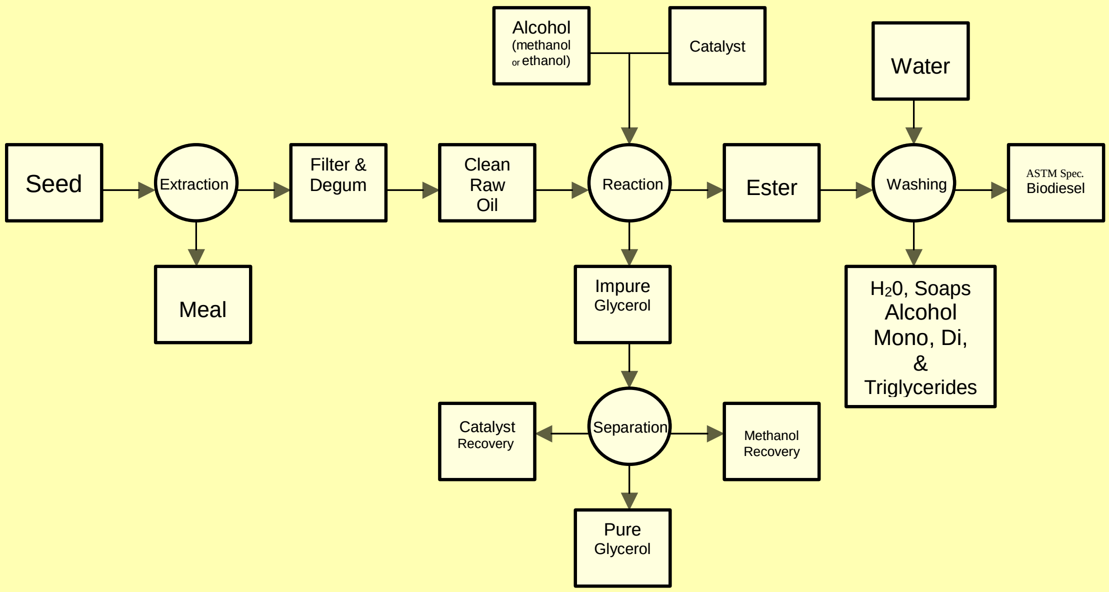
Methyl ester ingredients → Methanol = 0.225 x oil quantity in liters
KOH = Oil quantity in kilograms/100

While not commonly done in commercial plants ethanol can be used to replace the methanol but the amount of ethanol is slightly higher (oil in liters/0.27).

Biodiesel has been produced from nearly all types of vegetable oil and animal fat. Some of the feedstocks may require pre-processing processes like refining, degumming or filtering to improve the oil quality and to improve the yield of biodiesel. The oil must be dry or moisture must be removed by pre-heating and the alcohol must be anhydrous. Moisture will prevent the process from going to completion. Titration of the oil is used to determine the amount of catalyst required depending on the acidity of the fat/oil. If the fats/oils are high in free fatty acids (FFA), exceeding 3 or 4 percent, an acid treatment can be used prior to the esterification process to convert the FFA to esters.

The esterification reaction results in four main products – the methyl ester or biodiesel, glycerin which in the pure state has significant value, feed quality fats from unreacted triglycerides, and methanol that can be recycled back into the process. While the technology is a well-established process there are many different variations to achieve the desired result. In general terms the processing can be done by batch, semi-batch or continuous production. A schematic of the batch process is shown in Figure 5. The batch process, the simplest method for producing biodiesel, utilizes time to achieve separation of the various solutions created during the transesterification and washings to achieve quality biodiesel fuel. For more information on the chemistry and process of producing biodiesel refer to Van Gerpen, 2005 and Knothe, 2004.

Figure 5 - Schematic & Description of the Batch Process



Biodiesel Production Batch Process

Dissolve the catalyst in the alcohol (methanol or ethanol), or purchase a pre-blended mixture. Add the alcohol/catalyst mixture to the oil and stir the mixture vigorously. After two hours of stirring allow the mixture to settle for eight to twelve hours for the ester and glycerol mixture to separate. The heavier glycerol settles to the bottom and can be removed in a separatory funnel or with a centrifuge.

Following esterification additional processing is required to produce a suitable biodiesel. To assure meeting the glycerol standard some plants use a second esterification with about 10% the amount of alcohol to react any triglycerides remaining in the ester.

A water washing process is used to remove any remaining excess alcohol, glycerol, and triglycerides. Washing must be done carefully, especially processes using ethanol. If the process is not done carefully emulsions may form between the esters and the water. Water is sprayed at low velocity on top of a tall column of biodiesel. The water filters down through the biodiesel column carrying with it the remaining alcohol and glycerol. Following washing the ester is again allowed to settle so that the water will settle to the bottom where it can be removed. In some commercial operations the biodiesel is raised to a temperature just above the boiling point of water to evaporate any remaining water.

The process equipment for producing biodiesel is a series of tanks, pipes, pumps, heat exchangers, condensers, and valves. Figure 6 shows the requirements for a 1,000,000 gallons per year production plant with 30 days of on-site storage. Several commercial companies offer biodiesel processing plant design services. There are also companies offering skid mounted modular biodiesel plants for sale. Potential purchasers should investigate the process, sources, and suppliers very carefully to assure a quality installation and fully investigate the success of the contractor's previous installations. Regardless of the size or design of the plant development of operation should largely follow the development process flow chart shown in Figure 7.

Figure 6

Plant Requirements

For a

1,000,000 gallons per year Biodiesel Production Plant

With 30 days of on-site storage

1. The input side of the plant would need facilities to store 85,000 gallons of vegetable oil and 20,000 gallons of methanol.

2. If the oil were derived from seed, since most vegetable oil crops suitable for Idaho are annual crops, storage would be necessary for approximately 10,000 tons (350,000 bushels) of 40% oil seeds. This storage could be on-site or could be arranged off-site with local producers and/or growers.

3. If operated 300 days per year, the plant would need to process approximately 3,500 gallons of vegetable oil/animal fat per day.

4. If water requirements were 50% of the biodiesel process, approximately 2,000 gallons of water would be needed each day.

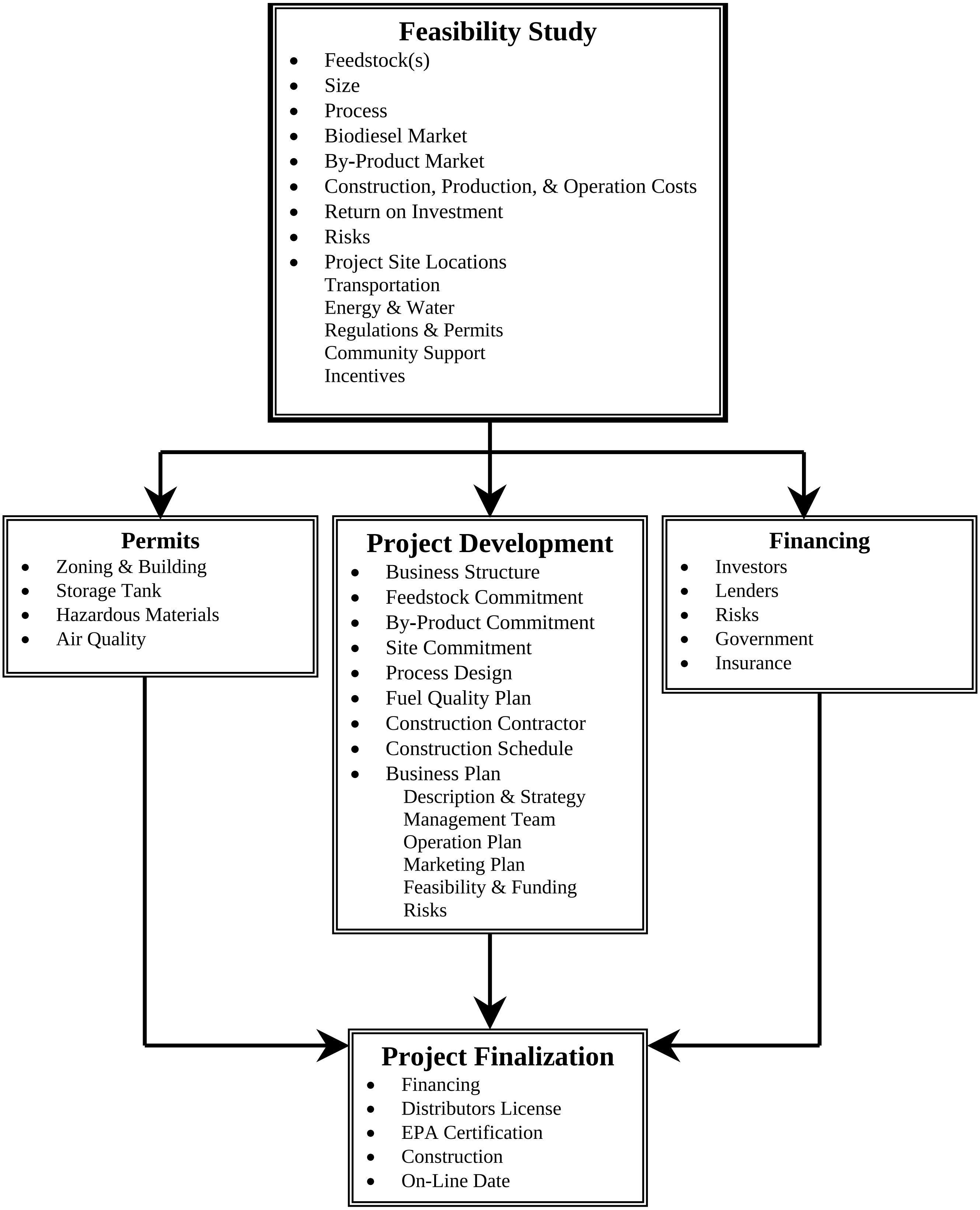
3. On the output side of the plant to have 30 days storage would require approximately 85,000 gallons of biodiesel, and 10,000 gallons of glycerol.

4. A methanol distillation unit would be required to remove excess methanol from 350 gallons of glycerol daily.

5. Rail or truck facilities would require 4 – 5,000 gallon loads of methanol per month; 17 – 5,000 gallon loads of fat or oil per month or 500 - 20 ton loads of oil seeds per year; 325 - 20 ton loads of meal leaving the plant per year; 17 – 5,000 gallon loads of biodiesel per month leaving the plant; and 2 – 5,000 gallon loads of glycerol leaving the plant per month.

Figure 7

Project Development Flow Chart



Fuel Quality

For a commercial operation there is no more important factor than producing a quality product. It is relatively easy for someone, even in his or her backyard, to produce a biodiesel fuel. It is not as easy or as inexpensive for one to produce a quality fuel that will meet requirements of a modern diesel engine. One of the first actions of the biodiesel industry was to develop a standard for biodiesel. This standard, known as “The Biodiesel Standard”, was created under the auspices of the American Society of Testing Materials (ASTM D 6751, Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels). The purpose is to provide a biodiesel product that meets the requirements for blending with diesel fuel in a manner that will not adversely affect engine operation or drivability. The complete standard can be purchased from ASTM. Further information on the standard is available on the ASTM website.

Every commercial biodiesel plant should have a plan for regular testing of its product to assure compliance. Table 2 provides an overview of the requirements. There are commercial operations that can perform the tests for a fee although there could be a large time lapse. Larger plants will need an analytical laboratory capable of performing many of the tests on-site.

Table 2 - Summary of Biodiesel Fuel Standard*

PROPERTY	LIMITS	METHOD
Flashpoint	130ºC min	D 93
Water & Sediment	0.050% max by volume	D 2709
Kinematic Viscosity, 40 ºC	1.9 – 6.0 mm^2/sec	D 445
Sulfated Ash	0.020% by wt max	D 874
Total sulfur	15 ppm max	D 5453
Copper Strip Corrosion	No. 3 max	D 130
Cetane Number	47 min	D 613
Cloud Point	Report in ºC	D 2500
Carbon Residue	0.050% by wt max	D 4530
Acid Number	0.50 mg KOH/gm max	D 664
Free Glycerin	0.020% by wt max	D 6584
Total Glycerin	0.240% by wt max	D 6584
Phosphorous	0.001% by wt max	D 4951
Vacuum Distillation End Point	360ºC max at T-90	D 1160
Sodium/Potassium	5 ppm max, combined	UOP 391

*ASTM D 6751, " Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels," ASTM International. For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

The approved specification for biodiesel ASTM D 6751 requires a sophisticated knowledge of the chemistry of producing biodiesel. The tests to ensure the quality of the fuel require expensive equipment. A small facility would require the same process quality assurance testing as a large one.

It is important to the industry that all commercial operations have a regular schedule for running all of the recommended tests suggested in the standard. When the U of I conducted the 200,000-mile Over-the-Road test of biodiesel in a large truck (Peterson, 2002), the tests were divided into two groups. The first group consisted of those portions of the standard that were not likely to change from batch to batch. In the second group were properties that could. Tests done for each batch included viscosity, free and total glycerin, flashpoint, and acid number. A separate and longer test interval was established for the second group of tests.

In addition to the standard, the National Biodiesel Board has established a BQ-9000 quality assurance program. As stated on the NBB website, "The National Biodiesel Accreditation Program is a cooperative and voluntary program for the accreditation of producers and marketers of biodiesel fuel called BQ-9000. The program is a unique combination of the ASTM standard for biodiesel, ASTM D 6751, and a quality systems program that includes storage, sampling, testing, blending, shipping, distribution, and fuel management practices. BQ-9000 is open to any biodiesel manufacturer, marketer or distributor of biodiesel and biodiesel blends in the United States and Canada."

Regardless of whether a company elects to participate in BQ-9000 or develop its own quality control program it is important to the future of the biodiesel industry that biodiesel placed for sale be of good quality. Diesel engines have many critical components that can be damaged resulting in expensive repairs if fuel clogs filters, contains water, has incorrect viscosity, has high acid value or is sub-standard in any of the other quality factors is allowed to enter the fuel system. When producing biodiesel as with any other product "Quality" must come first.

Engine Manufacturer Warranty Information

Most of the major engine manufacturers have released statements on biodiesel use relating to their engine warranties. In general they state that engine warranties are associated with failure due materials and workmanship regardless of the type of fuel used. Most suggest that only ASTM standard diesel fuel be used in their engines with some recommend a maximum of 5% biodiesel blended with diesel. Several of these statements can be found on the National Biodiesel Board website at: www.biodiesel.org

It is very likely that one of the impediments to acceptance of higher percentage blends of biodiesel by the engine manufacturer's is the wide spread lack of adequate quality controls in the processing of biodiesel by smaller producers. A second impediment is that biodiesel is still a relatively new fuel. As many millions of miles/hours of use are achieved it is likely that these recommendations will be liberalized if in fact general use of biodiesel is found to have no or few problems. Quality assurance by all segments of the industry, including both small and large producers, is essential if biodiesel is to be accepted as a standard component of transportation fuels.

VI. FEEDSTOCK AVAILABILITY

Feedstock for diesel production represents over 80 percent of the cost of producing biodiesel. Feedstocks for locally produced biodiesel can come from used oil from restaurants and food processing facilities, tallow from beef packing plants and similar sources or oilseed crops grown specifically for biodiesel production. The fact that biodiesel can be produced from recycled cooking grease, or what is commonly called "yellow grease", is partly the reason for the current publicity and excitement about biodiesel. Yellow grease is the cheapest feedstock but the supply is limited. There is competition for the available supply for uses other than biodiesel, and its use for biodiesel generally requires pre-processing. The largest type of feedstock currently available in the south central Idaho is tallow because of the large number of cattle in the area. Tallow is also the most problematic potential source. It is not the best feedstock for biodiesel production because it has a high free fatty acid content and the highest pour point of all the feedstocks.

Oil for a biodiesel plant can be brought in by rail from other areas. This is how Idaho's first commercial biodiesel production plant located in New Plymouth. Blue Sky Biodiesel, originally constructed to produce 10 million gallons of biodiesel a year, purchased an existing building along the rail line and began full operation in September 2006. The plant is expected to pay for itself within two years after operation begins.

The most desirable feedstock, and also the most expensive, is oil from seed crops, commonly called virgin oil. Soy oil is currently the largest seed crop and feedstock used to produce biodiesel in the United States. Soybeans could be grown in the Idaho but there is no current production and the experiments by agricultural research groups have not shown promising results. Varieties developed for the area might increase the feasibility of soy oil production in Idaho. Safflower and sunflower have been grown in the south central Idaho on a limited basis. Safflower is grown successfully in south central Idaho and has a high oil content and has good characteristic for biodiesel. Perhaps the greatest potential for producing biodiesel from locally grown crops in Idaho is rapeseed, canola and mustard from the Brassicas family. Brassica crops are grown across Idaho and can be grown in the south central Idaho. Oil from rapeseed and canola are considered premium feedstocks for biodiesel.

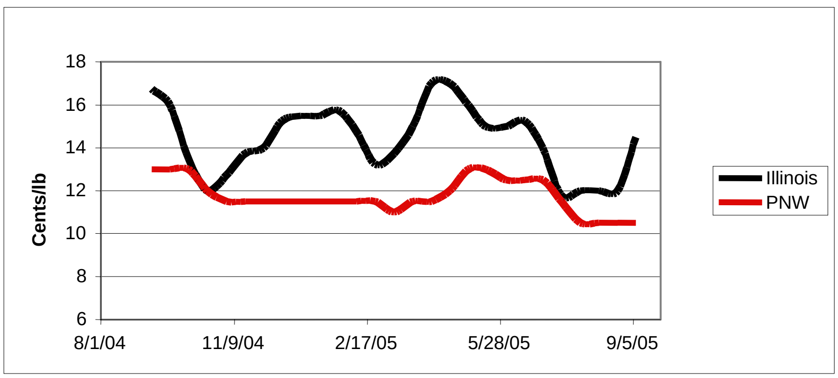
Since there are currently no commercial seed processing plants in Idaho, plants using oil from local seed crops would need to build a seed processing facility. That operation would be the second phase of the project and will be more costly and larger in scope than the biodiesel production plant.

Used Oil

According to estimates by the National Renewable Energy Laboratory (NREL) the quantity of used oil from restaurants and similar sources is about 1.1 gallons per person per year (Wiltsee, 1998). For the Magic Valley that estimate equates to 190,000 gallons per year. There also may be an additional 250,000 to 500,000 gallons per year from food processors. The value of yellow grease fluctuates over time and by location. Figure 8 shows the range of prices over the past year in Illinois the and Northwest.

Used oil in the Magic Valley is currently collected, processed, and then resold for feed, domestic industrial markets, and exported. To obtain yellow grease for biodiesel the facility would need to either purchase the product from existing renderers or set-up its own collection business in competition with the existing companies. The latter option should not be considered trivial. Purchasing trucks, hiring drivers, arranging for collection tanks with the various businesses, obtaining contracts, filtering and cleaning the oil all add cost to the oil.

Figure 8 - Yellow Grease Prices



Tallow

Based on the number of cattle and calves in the study area it is estimated that about 61,240,000 pounds per year of tallow are being produced in the south central Idaho. At 7.5 pounds per gallon this equates to 8.2 million gallons of oil. Recent changes in livestock feed regulations due to mad cow disease and other related problems have restricted the markets for this product. If process technology can be developed to successfully use tallow for biodiesel it is currently the most abundant and cheapest source of oil available in south central Idaho. Tallow pricing is generally a few cents per pound higher than yellow grease. As with yellow grease, a biodiesel facility would need to either purchase the tallow from existing collection companies or compete with them. Challenges with tallow for biodiesel production include high free fatty acid (FFA) content, high pour point and process requirements to produce a liquid.

The availability of tallow is dependent on a thriving meat packing business. Shifts in the size or location of these facilities would have a resulting effect on the biodiesel plant. As with yellow grease, there are uses for tallow, which would preclude some of the product from being used for biodiesel production. And as with yellow grease, either it would need to be purchased from an existing renderer or facilities and equipment would need to be developed to pickup and render the tallow useable for biodiesel production and to arrange for disposal of non-oil fractions.

In addition to an abundance of cattle, the Magic Valley is also the number one trout producing area in the United States. Biodiesel produced from fish oil has been done with considerable success in Alaska. However, the amount of fish oil produced in the Magic Valley was not determined in this study since most of the trout are sold whole and it is not expected there is a sufficient quantity available.

Oil From Outside the Area

Soybean oil is by far the most common oil used for biodiesel production because of its price and availability. Since the beginning of 2006, October soybean oil futures on the Chicago Board of Trade have fluctuated between 22.5 –27 cents per pound, with the most recent prices around 26 cents per pound. Since 7.5 pounds of virgin oil converts to a gallon of biodiesel, this represents a cost of about $1.69 – $2.03 per gallon of raw oil.

The latest USDA estimate for this growing season is for soy oil production to be up 6.9%, domestic consumption up 3.2%, exports at 15% lower and ending stocks to be up 61.% versus last season. Estimates for the 2006/07 season are for production to be up 3.2% versus 2005/06, domestic consumption up 5.6%, exports up 6.7% and ending stocks to be down 13.5%. It is currently estimated the United States soy oil refineries are running a steady 85% of capacity (Jacobsen, 2006). Obviously the biodiesel industry must look at forward pricing whether in terms of hedging the relevant futures, selective use of option or forward contracting in some form.

Using soy oil brought in from the Midwest or other areas for biodiesel feedstock poses a considerable risk. In January 2006 there were about 50 commercial biodiesel plants in nation. By May in the number had increased to 83. Nearly all these plants are using soy oil. Clearly the demand for soy oil from new biodiesel plants would potentially result in a significant rise in the soy oil price. Consequently, longer-term profits of a commercial biodiesel production plant in south central Idaho are dependant upon a local seed crop.

Oil From Local Seed Crops

The study area is known as the Magic Valley because of the magical transformation of a barren desert to a highly productive farming area when irrigation water was applied to the land. Much of the irrigation comes from canals but the area also sits above a large underground aquifer known as the Snake Plain Aquifer. The aquifer extends from Ashton to King Hill, a distance of about 130 miles and 70 miles wide or 10,000 square miles. The Magic Valley is one of the most productive cropping areas in the nation. Many of the crops grown here are grown to support the dairy industry. Primary crops are wheat, barley, oats, alfalfa, corn primarily for silage but some for grain, potatoes, sugar beets and dry beans. Most of the Magic Valley receives 10 to 15 inches of precipitation each year although there are pockets that receive 30 inches. The total cropland in the study area is about 1.4 million acres. Figure 2 shows the land type and use in south central Idaho and Table 3 shows the breakdown of cropland area by county.

In order for farmers to successfully grow seed crops in south central Idaho the crop must fit in with the growers' rotation and provide a reasonable financial return to the grower. Crop rotation is necessary for weed and disease control. Major crops grown in the study area, shown as the approximate percent of all crops, is shown in Table 4. Oilseed crops are not likely to replace the major cash crops like alfalfa, potatoes, and sugar beets, but could replace the small grains. Some growers may prefer oilseed crops for rotation since they have some advantages over those currently grown. Oilseed crops will still need to provide a return to the farmer at least comparable to the crops currently used for rotation.

Table 3 – South Central Idaho Agricultural Area, 2002

County	Total Area (Acres)	Cropland (Acres)	Harvested (Acres)
Blaine	1,699,200	52,670	33,114
Camas	689,280	83,930	63,323
Cassia	1,649,280	422,424	284,954
Gooding	469,120	120,479	100,711
Jerome	387,200	144,525	131,177
Lincoln	771,840	69,758	49.096
Minidoka	487,680	203,793	194,423
Twin Falls	1,252,480	268,011	217,786
TOTAL	7,406,080	1,365,590	1,074,584

Source: USDA, National Agricultural Statistics, 2002 (done every 5 years).

Table 4 – Major Crops Grown in the Study Area

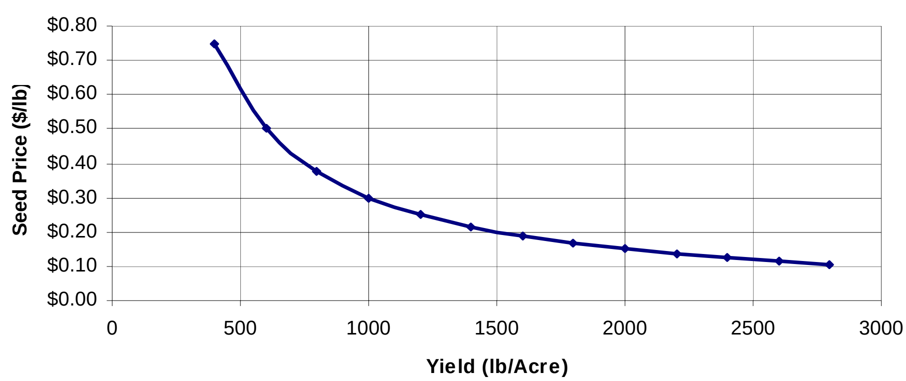
Crops	Percent Of Total
Small Grains	35
Alfalfa	30
Corn	15
Potatoes/sugar beets	15
Dry beans/Others	5

Source: Calculated from 2005 Idaho Agricultural Statistics

Based on comparisons with other crops used for rotation it was estimated that area growers would need to receive about $300 per acre on irrigated land in order to grow oilseed crops. A graph of the yield and price paid to farmers corresponding to $300 per acre is shown in Figure 9.

Four oil seed crops will be discussed with relation to their potential success in south central Idaho: Brassicas, safflower, sunflower, and soybeans. Most seed crops grown in the United States and in Idaho are dry land farmed. The information available for these crops in the study area, which is primarily irrigated, is limited. Much of the following discussion is based on interviews with agricultural extension agents, farmers and others familiar with farming in the study area. Growers planning to use these crops for biodiesel production should conduct field trials under their conditions to determine yield potential.

Figure 9 - Crop Yield and Seed Price to Farmers at $300/Acre



Brassicas

Oilseed rape (Brassica and related species, Brassicaceae) is now the second largest oilseed crop in the world, providing 13% of the world's supply (Raymer, 2002). Brassicas are the mustard family, also known as "crucifer," which includes rapeseed, canola, yellow mustard, cabbage, and turnips, as well as many weeds and garden vegetable species. Although rapeseed can refer to both the edible and industrial oil types, it has become common to mean the non-edible type. Rape is classified as an industrial crop because of its high erucic acid content, which is used in lubricants, diesel additives and to manufacture plastics. Canola is rapeseed that meets food quality standards with low levels of erucic acid and sulfur containing compounds called glucosinolates.

Canola and rape are cool season crops, which are grown in the northern plains area of the United States and Canada. There are both winter and spring cultivars. Canola and rape are commonly grown in the Palouse area of northern Idaho and south central Washington, the west-central Idaho Camas Prairie and the American Falls area. The University of Idaho has in fact used Brassicas grown on the Palouse extensively in biodiesel research (Figure 10). In 1996, Idaho planted about 6 percent of the national acreage.

Figure 10 - UofI Volkswagen, which runs on 100% biodiesel from mustard seed oil, sits on a Rapeseed field on the Palouse.

Brassicas are well adapted to the dry land farms of the Pacific Northwest and provide important advantages in a sustainable crop rotation system with wheat. They break up pest cycles and help minimize the use of synthesized chemical pesticides. The University of Idaho has reported that rapeseed and related crops also may reduce disease populations in potatoes when the crop followed rapeseed or rapeseed as a green manure. Populations of nematodes, potato scab, and rhizoctonia were reduced by crops with high glucosinolates (Findlay, 2003). They also condition the soil so that follow-on wheat crops provide better yields. Existing small grains equipment can be used to plant these crops, but the seedbed must be more uniform and weed-free than for the small grains (Weber, 2005).

There is limited available information on the success of growing Brassicas under irrigation. In northeastern central Colorado, it was found the yield was linear to water at 175 pounds per acre per inch of water after the first 6.22 inches. Water extractions were from the top 47 inches of the soil profile. Rape was most sensitive to water stress during the grain-filling stage and least sensitive during vegetative development (Nielsen, 1996).

A farmer in Camas County near Fairfield has grown canola under both dry land and irrigated conditions near an elevation of 5,020 feet. In 1989, 35 acres of spring canola were planted under irrigation, which was limited to 8 inches of water. The yield was 2,500 pounds per acre. In 1991, 525 acres were planted under dry land conditions, which was the first year of the drought. The crop received no rain that season and the yield was only 200 pounds per acre. The dry land crop had higher oil content, about 42%, than the irrigated one. Recently the farmer has been growing yellow mustard under organic conditions as a dry land crop. About 100 to 150 acres are planted each year with a yield of 200-300 pounds per acre (Frostenson, 2005).

The 2004 state average yield for canola was 1,500 pounds per acre (Idaho Agricultural Statistics, 2005). On the Camas Prairie near Grangeville rape is dry land farmed and yields of 3,000 pounds per acre are common. The wide range in rape yields demonstrates the affect climate has on the crop. Rapeseed in Idaho is used for birdseed or shipped out of state for processing.

The University of Idaho has conducted crop costs and returns estimate for irrigated and low rainfall dryland spring canola for southsouth central Idaho (Patterson, 2005). These studies estimated irrigated canola would yield 2,400 pounds per acre and cost $420.95 per acre. Yield for dryland canola was estimated at 1,400 pounds per acre with a cost of $197.40 per acre. The complete reports are included in the appendix.

Yellow mustard (Sinapis alba L.) is another Brassica crop that is widely discussed for potential feedstock for biodiesel. According to Brown et al. (2005) yellow mustard is a spring annual well adapted to hot, dry growing conditions. It has superior heat and drought tolerance compared to rapeseed or canola. It has 55% higher seed yield than canola in areas of the Pacific Northwest that receive less than 12 inches of rainfall. It also has higher yields than spring canola in areas that receive more than 12 inches of annual rainfall. Yellow mustard is a relative of canola, rapeseed and oriental mustard but will not cross-pollinate with these crops under field conditions.

Four years of field trials with yellow mustard on dry land in the Pacific Northwest averaged 1,419 pounds per acre. Brown, et al. (2005) report that the expected average seed yield can be found by multiplying the expected rainfall in inches by 95 pounds per acre up to 18 inches of rainfall. A grower in the 12-inch rainfall area could expect 1,140 pounds per acre. However, many other agronomic factors, such as seeding time and rate, weeds, fertilizer, soil type, disease and insect control, can also influence the yield. Unfortunately, the oil content was not reported. Peterson et al. (2001) reported that two cultivars of yellow mustard had 27 percent and 35 percent of oil content. Similar oil content was reported by Oplinger et al. (1991). Using 1,500 pounds per acre, 35 per cent oil, and 90 percent extraction efficiency would give an estimate of 63 gallons per acre of yellow mustard oil. Peterson et al. (2001) reported results similar to other Brassica oils in so far as potential for biodiesel was concerned.

Reportedly, additional benefits of yellow mustard are reduced production inputs, potential use of meal for condiment mustard and for a soil amendment to replace or reduce herbicides and pesticides. Because the meals are high in glucosinolates they are not suitable for livestock feed.

The oil content of Brassicas is about 40 to 45 percent, compared to about 20 percent for soybean. Tests at the University of Idaho also indicate Brassica oils provide superior low temperature properties for the biodiesel. Brassica crops have high levels of mono-unsaturated fats and low levels of saturated fats, usually between 4 and 6 percent but less than 2% for some varieties. The saturated fatty acid chains determine the gel point of the fuel and when the level of saturates are 14-15%, as is typical of soybean oil, the fuel will gel at about 32ºF. When the level of saturates is 40%, as in animal fats and recycled restaurant frying oils, the fuel will gel at 50 to 55ºF. Preliminary testing shows that Brassica-based biodiesel is lower than soybean oil but still cannot approach the cold weather performance of conventional diesel. Brassica has a gel point of 20-25ºF while No. 2 diesel has a gel point of 1-15ºF (He, 2006).

Safflower

Safflower (*Carthamust Tintorius* L.) is a member of the thistle family. It is grown for oil and birdseed in plains of Canada and the western plains states of North and South Dakota, Nebraska, Colorado, Texas, and in California. Safflower is a deep-rooted long season annual that can grow on dry and irrigated lands. Its tap root system can utilize moisture and nutrients in the soil below that of small grains. (Lethbridge Research Center, 2004 and Berglund, 1998)

Safflower provides meal, oil, and birdseed. Both the food and industrial segments use safflower oil, which can be high in monounsaturated fatty acid (oleic) or high in polyunsaturated oils (linoleic). The oil content of cultivars varies from 30 to 45 percent. The meal, which is about 24 percent protein and high in fiber, is used as a protein supplement for livestock and poultry.

Although safflower is often considered a dry land plant, it does respond well to irrigation. It can produce a seed crop on as little as 16 to 18 inches of moisture. In the central valley of California under irrigation, about 20 to 25 inches of water is required for economic yields. With 25 to 40 inches of rain/moisture the relationship is about 100 pounds of seed per inch of evaportranspiration (University of California, Davis. 1999). In field plots in Montana and North Dakota, safflower out produced sunflower, mustard, soybean, crambe, flax, and rapeseed (Croissant, 2005). In North Dakota about 5 pounds of nitrogen is required per 100 pounds of seed produced (Armah-Agyeman, 2002).

Safflower is reportedly a good crop to grow on hard soils since the deep root system will penetrate and fracture the soil. It is best to plant early so that flowering can occur before the hot period of late summer. This practice was also said to reduce the occurrence of *Phytophthora* spp., a disease that has the potential to greatly reduce yields.

Safflower has been grown in several areas across southern Idaho in small amounts. In Canyon County for instance, an Ethiopian confectionary variety has been grown with a yield of about 3,000 pounds per acre. In Washington County, where total moisture is about 10 to 11 inches per year, a farmer has grown safflower for 20 years. Most of it has been a white seed S208 variety grown for birdseed with an oil content in the 40 to 42 percent range. As a dry land crop, yields ranged from 800 to 1,000 pounds per acre. As an irrigated crop, the yield ranged from 1,500 to 3,800 pounds per acre. The farmer found that yields were lower if the crop was irrigated during flowering and returns were greater for safflower than for small grains (Lolley, 2005).

Sunflower

Sunflower *(Helianthus annuus* L.) is a plant that was used for food by the North American Indians before European colonization. The sunflower has traveled the world since then, and been hybridized into two types: confection (non-oil) and oil types. The oil content of the varieties can vary from 38 to 50 percent (North Dakota State University Agricultural Experiment Station, 1995).

As with safflower, sunflower has a deep root system that can extract water and nutrients from the soil profile deeper than small grains. It responds to irrigation with yields increasing at about 150 pounds of seed per inch of water after the first 7 inches. Row crop equipment appears to work better than small grain equipment to farm sunflowers. It should not follow itself in crop rotation in less than 4 years to manage diseases (North Dakota State University Agricultural Experiment Station, 1995 and Thomas Jefferson Agricultural Institute, 2005).

Sunflower was evaluated in alternative crops trials for the Palouse country of north Idaho and south central Washington by Kephart (1990). The seed production did not fare well due to different equipment required, the dry, hot summer environment, and limited production experience. Sunflowers have also been grown in southwest Idaho. The crop is harvested with modified small grain combines. In all cases black birds and starlings imposed a great deal of damage to the yields (Shock, 2005).

Soybeans

In contrast to other oil seed crops mentioned above, soybeans produce oil content of 17 to 20 percent. To extract the soybean oil on a commercial basis, in the Midwest a hexane solvent extraction process is used (Feibert, 1999).

Commercial varieties of soybeans are not adapted to south central Idaho's cool night temperatures and low relative humidity. The Oregon State University Malheur Experiment Station is developing varieties of soybeans that are adapted to the area's climatic conditions. Some new varieties are yielding 40 to 60 bushels per acre. The meal remaining from extracting oil from soybeans is a widely used high protein product desirable for livestock feed and many other uses.

Potential Production of Oil from Local Seed Crops

Oils can be extracted from oilseeds by either mechanical press (expeller) or solvent extraction. The chemical solvent extraction, or the hexane process, is very effective leaving about 1 percent oil in the meal. Most of the soy oil produced is from the hexane process but it is expensive and hazardous. Physically pressing the seed is less effective, leaving about 9 percent oil in the meal, but produces a meal that has greater value. Since there are currently no commercial seed processing plants in Idaho, plants using oil from local seed crops would need to build a seed processing facility. While an assessment of developing a seed processing plant is beyond the scope of this study, that operation may be more costly and larger in scope than the biodiesel production plant.

The Integrated Cropping Systems group at Prosser, Washington has been evaluating the production aspects of seed crops for biodiesel production in high value irrigated vegetable rotations. One of their objectives is to determine the best yielding cultivars as a biodiesel feedstock for the Pacific Northwest. A summary of their findings as they related to the south central Idaho is shown in Table 5.

Table 5 – Yield Data for 2004-05 Trials at Patterson, WA*

CROP	VARIETY	YIELD (lb/ac)	Oil Content (%)	Biodiesel Yield (gal/ac)	Area need to support 5-Mil Gal Facility
Spring Rapeseed	Garnel	1,876	40-45	113	44,334
	Sterling	1,770	40-45	108	47,058
Spring Mustard	Idagold	1,306	25-27	52	95,466
	Pacific Gold	2,194	25-27	88	56,862
Safflower	CA	2,545	42-48	146	34,250
Soybeans	S191B-4	3,881	20-22	104	48,227

*Source: Collins et. al., 2005

Additional benefits to Magic Valley farmers to grow oil seed crops may include a reduction in water, soil amendments and insecticides. Government incentives may also be available to provide additional return on investment. The Farm Security and Rural Investment Act of 2002 included a provision for buying down the cost of feedstocks to increase production of renewable fuels. Under this program the Commodity Credit Corporation (CCC) pays market prices for the feedstock to biodiesel producers. In 2004, for instance, a 5 million gallon per year biodiesel plant using canola oil for feedstock would be paid the market price for up to about 15.4 million pounds of canola seed. The CCC program is only funded through 2006 and has not been funded to authorized levels in recent years with reimbursement at about 35 percent of the calculated amount.

Based on the current rotational practices of area farmers it was determined that oilseed crops could reasonably be expected to be planted on 10-20% of the harvested cropland in the study area. This represents about 30-60% of the small grains currently grown in the study area. Actual acreage will depend on price, success of the growers with the crop and crop rotation. The state average yield for Canola is 1,500 pounds per acre (Idaho Agricultural Statistics, 2005). It is believed that growing oil seed crops in the south central Idaho under irrigation would result in yields greater than those published for Canola. For the following estimates it was assumed that the average yield under irrigation would be in the 1,500 to 2,500 pounds per acre range, with oil content of the seed 40 percent, press recovery 90 percent, and a gallon of oil weighs 7.5 pounds. Using these estimates an acre of oil seed crop would produce the equivalent of 72 to 120 gallons of biodiesel per acre. The estimated oil production from local seed crops, shown in Table 6, ranges from 7.7 to 25.8 million gallons per year

Table 6 - Estimated Oil Production from Local Seeds Crops

	RANGE	
	LOW	HIGH
Total Harvested Cropland	1,074,584 Acres	
Acres for Oil Seeds*	107,460	214,920
Oil Production @ 1,500 lb/acre**	7,737,120 Gallons	15,474,240 Gallons
Oil Production @ 2,500 lb/acre***	12,895,200 Gallons	25,790,400 Gallons

* Based on 10 and 20 percent of the small grain
** State average yield
*** Estimated yield with irrigation

Feedstock Production Summary

It is estimated that no more than half of the available used oil and tallow could be obtained for biodiesel production. The potential range for growing a local seed crop depends on if the crop can provide a reasonable rate of return to the grower and whether the crop fits in the farmer's rotation. It is currently limited because the Agricultural Order for limiting Brassicas in the study area. Table 7 shows the estimated range of the biodiesel production from the various feedstocks.

Table 7 - Summary of Potential Feedstock Sources

FEEDSTOCK	TOTAL SUPPLY (THOUSAND GALLONS)	EST. AVAILABLE SUPPLY (THOUSAND GALLONS)
Waste grease*	190	95
Oil from food processing*	250 to 500	375
Tallow*	8,200	4,100
Oil from oil seeds**	--	7,735 to 25,790
Total Estimated Supply		**12,305 to 30,360**

* One-half of the total supply

**107,458 to 214,917 acres @ 72 to 120 gallon/acre

V. MARKETING OPTIONS

Marketing is one of the most important aspects to the success of any business and vital for a commercial biodiesel plant. Once the plant begins operation the products need to be moved without interruption. In addition to biodiesel, the plant will produce glycerin and, if the feedstock is from seed, meal. While a complete marketing analysis is beyond the scope of this document, it is critical that parties investigating the development of a commercial facility have a firm plan for the marketing of their products.

Biodiesel Markets

A growing number of firms market biodiesel nationwide as a replacement or additive to diesel fuel. An inherent advantage of biodiesel is selling to local markets, and it provides the best opportunity to get the highest price for the product. Idaho consumes about 1.2 million gallons a day of diesel. Table 7 shows the diesel consumed in Idaho by the type of use and the estimated diesel market in the study area. The estimated on-highway diesel use in the study area was estimated by using the percentage of the Idaho population in the study area (12%). The same percentage and procedure were used for all other uses except for farm and military consumption. Farm diesel use was based on the state percentage of harvested cropland within the study area (25%). Most of the military diesel use in Idaho is by Mountain Home Air Force Base with is not located within the study area. The last two columns in Table 7 show the potential markets at 20% and 5% saturation. Based on these assumptions the potential market for biodiesel in the south central Idaho ranges from 3 to 12 million gallons per year.

Table 8 – 2004 Idaho Diesel Consumption & Estimated Biodiesel Markets

DIESEL USE	------------THOUSAND GALLONS ------------			
	IDAHO* DIESEL USE	South Central Idaho DIESEL USE	South Central Idaho 20%	South Central Idaho 5%
On-Highway	238,093	28,570	5,715	1,430
Off-Highway**	35,574	4,270	850	210
Industrial	22,829	2,740	550	140
Residential	19,818	2,380	475	120
Commercial	19,171	2,300	460	115
Farm	63,126	15,780	3,150	790
Railroad	24,073	2,890	580	145
Military	62	-	-	-
Other	24	3	-	-
Totals	**422,770**	**58,930**	**11,780**	**2,990**

*Energy Information Administration, 2004.

**Off-highway use includes construction equipment, stationary generators, air compressors, logging equipment etc.

Federal and state programs, increases in the price of diesel, and growing public interest have resulted in a dramatic growth in the use of biodiesel during the past few years. The Energy Policy Act (EPAct), amended by the Energy Conservation Reauthorization Act of 1998, included biodiesel fuel as a way for federal, state, and public utility fleets to meet requirements for using alternative fuels. Pure biodiesel (B100) is considered an alternative fuel under EPAct. Lower-level biodiesel blends are not considered alternative fuels, but covered fleets can earn one EPAct credit for every 450 gallons of B100 purchased for use in blends of 20% or higher. Executive Order 13149, signed in April 2000, also directed federal fleets to reduce their consumption of petroleum by 20%. This Executive Order also required the use of alternative fuel in alternative fuel vehicles (AFV) purchased under EPAct (see the EPAct Alternative Fuels Web page).

Several other federal policies will affect the biodiesel market. The Energy Policy Act of 2005 signed into law in August 2005 (Public Law 109-58), included a renewable fuels standard (RFS) that mandates 7.5 billion gallons of renewable fuel be incorporated in the national fuel pool by 2012. The primary focus of this mandate is ethanol but biodiesel is a qualifying fuel. Federal policy that is likely to have the biggest impact on the biodiesel market, however, is the Environmental Protection Agency's (EPA) rules, under 40 CFR Part 80, to reduce sulfur in diesel from 500 ppm to 15 ppm. Terminals had until September 1, 2006 to complete their transitions to ultra-low sulfur diesel (ULSD) and retailers had until October 15, 2006. Since biodiesel, even in small percentage blends, effectively replaces sulfur and is more attractive in many respects to other sulfer replacement additives, this may be the single largest factor introducing biodiesel into the mainstream market.

Several state entities are also encouraging the biodiesel market. Beginning in early 2001, the Idaho Energy Division and Community Planning Association of Southwest Idaho (COMPASS) started the "Idaho B20 Project" to help coordinate the commercialization of biodiesel with businesses and government agencies. Under the program the Energy Division paid any increased cost difference between diesel blended with 20-percent biodiesel (B20) and diesel fuel to allow fleets to test biodiesel in their operations and transition them into full scale B20 use. With the cooperation of fuel distributors, several fleets including school buses, trash-collecting companies, the Idaho Department of Transportation and several others began using B20 in early 2002. On April 15, 2003, the first public B20 biodiesel pump in Idaho was opened in Boise and two card-lock Pacific Pride stations opened soon after. In March 2006 the Energy Division issued a statewide Request for Proposals (RFP) offering $289,000 to help install biodiesel infrastructure. As a result of this RFP about 36 stations from Sandpoint to Boise now offer biodiesel-blended fuel to the public.

As a result of a University of Idaho project, Yellowstone Park was the first National Park that used biodiesel. Now there are at least 23 National Parks using biodiesel across the county. The Idaho National Laboratory currently uses biodiesel in their buses. The Treasure Valley and Greater Yellowstone Clean Cities Coalitions, also actively promote biodiesel use.

Figure 11 - Idaho Department of Transportation advertises using biodiesel.

According to a survey conducted by the University of Idaho in 2003 and 2004, cost is the principal marketing driver for acceptance of biodiesel in the South central Idaho (Kinsey, 2004). Biodiesel does have benefits that make it attractive to many users. Other market drivers for biodiesel are:

- Non-Toxic, Biodegradable, Renewable
- Very Favorable Energy Balance (3.2 to 1)
- Air Quality Improvements
- Smoke & Odor Are Much Better
- Energy Independence
- Requires No Engine Modifications
- Can be Blended in Any Proportion with Diesel
- High Cetane Number & Excellent Lubricity
- Very High Flashpoint (>300^{0}F)
- Can Be Made From Recycled Restaurant Oils & Animal Fats

In addition to on-highway use, biodiesel can be used for home heating oil and boiler fuel. Using biodiesel as an additive to home heating oil has been a successful and growing trend in the mid-Atlantic and northeast United States. A registered heating fuel, known as "bioheat", has 5% biodiesel meeting ASTM D6751 specifications, blended with No. 2 home heating oil.

Factors Affecting the Acceptability of Biodiesel in Idaho

There are various factors, which make the availability of biodiesel acceptable in Idaho. One such factor is the knowledge and awareness about biodiesel among the diesel and biodiesel customers in regions where biodiesel is available, which in turn contributes to biodiesel demand. A survey was developed and administered to gage the knowledge and perception of biodiesel by diesel and biodiesel customers. Forty percent of all customers surveyed had not heard of biodiesel and another 40% were participants in a biodiesel buydown program. Through analysis of the survey, it was determined that most people are not willing to pay much extra and may well not pay any premium to use biodiesel. Although participants agreed that biodiesel use would decrease demand of imported oil, is beneficial environmentally, could increase use of local agriculture, and potentially boost the economy of the state, these factors did not surpass the overlying issue of cost. *Kinsey, 2004*

Glycerin

Biodiesel production generates glycerin, also known as glycerol or glycerine, as a byproduct of the transesterification reaction. Determining what should be done with the glycerin is one of the fundamental questions facing a potential biodiesel plant developer. Glycerin is used for many products. Table 9 shows the worldwide consumptions and uses of glycerin. Glycerin produced from the transesterification process contains methanol or ethanol, soap, catalyst and any impurities of the process. Before it can be sold in the glycerin market it must be purified. Equipment for refining glycerin is expensive and generally not justified for most biodiesel operations. There is also considerable risk since a large number of biodiesel plants can easily saturate the glycerin market as it has in Western Europe.

If the alcohol is removed from glycerol, which is relatively easy and cost-effective for a commercial biodiesel plant, it can be used as an additive in cow rations at the rate of about one pound per cow per day (Mann, 2005). The number of cattle in the south central Idaho is provided on Table 10. Table 11 shows the glycerin production from a given plant size and number of cows that would be needed to use the subsequent glycerin production. From this it can be seen that the number of cows in the south central Idaho is more than adequate for utilizing the glycerol as cattle feed.

The impure glycerol could also be use in biomass combustion plants for heat and/or electric power. The energy content of glycerol is about 91,000 BTU per gallon as compared to No. 2 diesel at 140,000 BTU per gallon. In a 1 million gallon per year biodiesel plant 750,000 pounds of glycerin would be produced with a potential value of 21-cents per pound, based on heating oil value of $2.50 per gallon.

Table 9 - Production, Consumption, and Uses of Glycerol, 2001*

	--------- THOUSAND TONS -------			
USES	U.S.	EUROPE	JAPAN	TOTAL
Annual capacity	169,000	315,000	59,000	543,000
Production	159,000	247,000	53,000	459,000
Consumption				
Personal/oral care	75,000	46,000	15,500	136,500
Pharmaceuticals	14,000	24,000	23,000	61,000
Food/beverages	42,000	27,000		69,000
Polyether polyols	17,000	33,000	6,000	56,000
Tobacco	22,000	15,000	5,000	42,000
Alkyd resins	6,000	17,000	7,500	30,500
Other	13,000	79,000	29,000	121,000

* Source: Chemical Economics Handbook

Oil Seed Meal

If oil seeds are crushed to produce oil for biodiesel plant production a meal will be left after removing the oil. Meal from seed crops grown in the Northwest has the potential to be a valuable commodity but the markets have not been established. Meal can be used as soil amendments, soil fumigants, pesticides, herbicides, fertilizers, and food additives for human and animal consumption. The value of the meal for many of these applications is high, but several steps need to be taken in order to realize this value. Mustard and rape meal, for instance, has not gone through the testing and labeling required by the Environmental Protection Agency as a soil amendment or pesticide.

Table 11 - Glycerin Production vs. Plant Size and Required Market as a Ration Component*

Plant Capacity (million gal)	Glycerin (million lb.)	Required Cows
0.5	0.37	1,000
1	0.75	2,000
4	3	8,200
12	9.0	24,700
18	13.5	37,000

*Assumes glycerin as ration component of 1 lb/day/cow.

Since there is a large number of livestock in south central Idaho (see Figure 12), livestock feed is the most likely market for oil seed meal. Meal from crushing facilities contains residual oil, protein, and fiber. Safflower seed meal, for instance, contains about 24 percent protein, 5 to 10 percent oil depending on the efficiency of the expeller, and about 50 percent fiber (Thomas Jefferson Agricultural Institute, 2005). Table 12 shows the suitability of the potential oil seed crops for livestock feed and the estimated value. The value of the meal for feed is based on the protein content. Based on this, and using soybean meal as the basis, safflower meal would be worth about $125 per ton using Portland, Oregon, prices on August 17, 2005. Meals high in glucosinolates are not suitable for feed. Table 13 shows the meal production from various biodiesel plant sizes, and the number of livestock that would be needed to support the plant assuming five pounds per day per cow.

Table 12 - Byproduct Utilization: Oil Seed Meal Value

Oil Seed Crop	Suitable for Feed	Protein (%)	Value ($/Ton)*
Safflower	Yes	25	120
Sunflower	Yes	50	239
Yellow mustard	**		
Canola	**	36	172
Rapeseed	**	36	172

*Based on the price for soybean meal with 47% protein using the Portland, Oregon price in 8/17/2005 of $225 per ton.
** Depends on the glucosinolate content.

Table 13 - Oil Seed Meal as a Ration & Cows Required

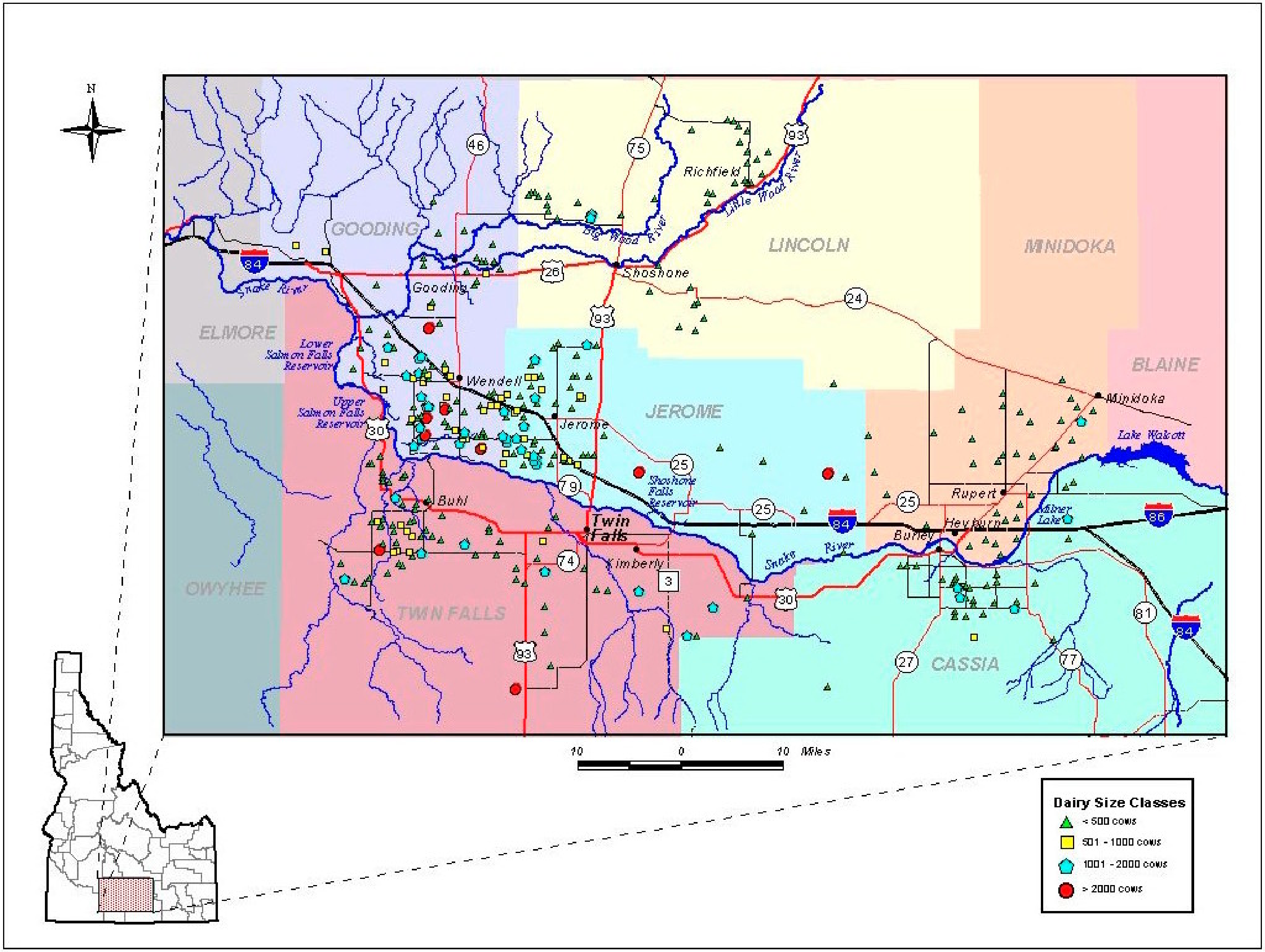
Plant Capacity (Million Gallons)	Meal Production (Tons)	Dairy Cows Required*
0.5	3,300	3,600
1.0	6,700	7,300
4.0	26,700	29,200
12	80,000	87,000
18	120,000	132,000

* Assumes 5 lb/day/cow in ration.

Final Note

Potential biodiesel developers often underestimate the importance of the marketing of biodiesel. Developers are making a big mistake if they just assume that if biodiesel is produced it can be sold for a reasonable price. Biodiesel is in direct competition with the petroleum industry, which controls the market. In Idaho the petroleum oligopoly largely dictates what is in the fuel sold at the pump and it is not generally in their best interest if it is a product that comes from a source other than their own.

Figure 12 – Dairies in the Magic Valley (IDWR, 1999)



VI. PLANT COSTS & REVENUES

Capital Costs

The process equipment for producing biodiesel is a series of tanks, pipes, pumps, heat exchangers, condensers, and valves. Several companies offer turnkey biodiesel plant design and installation services. With the current interest in biodiesel turnkey plant developers are getting a high price for their services and many require that they have a portion of the plants' ownership. Developers using this approach should thoroughly investigate the process, sources, and suppliers to assure a quality installation and fully investigate the success of the contractor's previous installations. Table 14 shows the estimated general cost of various plant sizes using contractors that have a history of successful installations with a proven process. This cost does not include the cost of land, buildings, utility installation, wastewater treatment, or rail spur development. Actual capital costs will be influenced by a variety of site-specific factors and the variety and quality of feedstocks. Processing multiple feedstocks will be more costly than processing oil from a single source.

Table 14 - Estimated Capital Cost for a Biodiesel Facility

Annual Production (Million Gallons)	Capital Cost per Gallon
0.5	$2.00
1.0	$2.00
5.0	$1.25
20	$1.00

The transesterification process is seemingly simple and many developers have and are putting together their own team of experts to design and install the plant equipment. While this may significantly reduce the capital cost of the plant, it is also likely to cause significant delays in plant start-up and can result in an inefficient plant that is not competitive.

Operation Costs

The cost of producing biodiesel will vary with the size of the facility and the feedstock. Feedstock is by far the largest cost of producing biodiesel. If the cost of refined oil were $0.27 per pound, the value of the virgin oil in the finished product would be about $2.03 per gallon ($.27 x 7.5 lb/gal.). In contrast, if yellow grease was purchased at the approximate average Pacific Northwest price of $0.12 per pound (Figure 8), the cost of the oil feedstock in the finished biodiesel would be about $0.90 per gallon. Yellow grease and tallow do require additional handling and treatment that will add to the cost, but it is not significant compared to the feedstock cost.

The cost of producing biodiesel from oil seeds grown in the Magic Valley would depend on the price paid to the producer, cost of expelling the oil from the seeds, and the efficiency of the expeller. From seed to refined, bleached and deodorized (RBD) oil it the assumed cost was $0.065 per pound of seed, which equates to $0.04 per pound for clean and handling and $50 per ton for crushing and filtering. Assumptions used to estimate operation costs are shown in Table 15.

The total cost for operating a plant using different feedstocks are shown in Table 16. The size of the plant is based on the estimated amount of available used oil and tallow in the study area. The table uses 470,000 gallons of yellow grease and 4.1 million gallons of tallow. The equivalent for a local crop is 48,083 acres with a 2,500 pounds per acre yield, 40 percent oil content and a seed press efficiency of 90 percent.

It can be seen that the low cost of yellow grease and tallow result in a considerably lower cost for biodiesel. There are, however, governmental incentives that are better for virgin oils and are discussed in the following section. More importantly, there is a limited amount of yellow grease and tallow available. Production from oil seed crops, either shipped or grown locally, must be used for larger plants.

Table 15 – Processing Cost Assumptions

PROCESS	COST ASSUMPTION	COMMENTS
Used Oil (yellow grease)	$0.12 / lb	Approximate Northwest average
Tallow	$0.135 / lb	1.5-cents higher than yellow grease
Oil Seed	$0.10 / lb	Approximate 2004 canola seed price
Crushing & Filtering	$0.065 / lb	$0.04/lb C&H - $50/Ton Crushing
Methanol	$2.30 / Gal.	Assumes 0.25 gal per biodiesel gal 50% used in process & 90% recovery
Catalyst	$1.80 / kg	10% of biodiesel (lb)
High FFA Processing	Methanol	2.3 lb methanol per lb FFA
	Catalyst	5 lb catalyst per lb FFA
Oil Freight	$0.02, 0.8, & 0.14 / Gal.	Locally produced, used, or shipped
Methanol Freight	$0.14 / Gal.	$4,200 per 30,000 gal rail car
Catalyst Freight	$0.10 / lb	
Operation Costs	$0.20-$0.30/Gal of Biodiesel	From Van Gerpen et.al., 2005*

Table 16 – Processing Costs as a Function of Feedstock

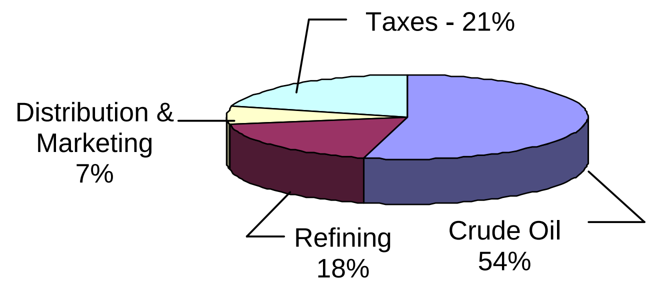
FEEDSTOCK	YELLOW GREASE + TALLOW*	RAILED IN SOY OIL	LOCALLY GROWN OIL from 38,083 A @2,500 LB/A
Plant Capacity	**-------- 4,570,000 GALLONS/YEAR --------**		
Oil Feedstock	$4,574,250	$9,254,250	$15,709,375
Chemical Feedstock	2,672,390	1,722,580	1,722,580
Freight & Handling	551,235	762,048	213,650
Operation & Maintenance	1,314,635	1,288,990	1,288,990
Total Cost	**$9,112,509**	**$13,027,865**	**$18,934,590**
Cost/Gallon	$1.99	$2.85	$4.14

* 410,000 gallons Yellow Grease, 4,100,000 gallons Tallow

Revenues

As indicated in the Marketing Options chapter, on-highway diesel is by far the largest market for biodiesel. According to the Energy Information Administration, the price breakdown for diesel at the pump is 72 percent for the crude oil and refining, 7 percent for marketing and distribution, and 21 percent for taxes (see Figure 14). The federal excise tax on on-highway fuel is 24.4 cents per gallon. The State of Idaho adds another 25 cent per gallon. There are federal incentives that encourage biodiesel and are critical for making a commercial biodiesel plant feasible.

Figure 13 - On-Highway Diesel Cost Breakdown



Source: Energy Information Administration, 2005

The biodiesel industry competes directly with the petroleum oligopoly, which has and is likely to continue to receive considerable governmental incentives (see Figure 15). Without corresponding incentives the biodiesel industry, now in its infancy, will not be able to compete. Consequently, the evaluation of potential revenues from a biodiesel plant needs to include the tax incentives. It should be noted, however, that this poses considerable risks since the major incentives to encourage biodiesel currently in effect are scheduled to end at the end of 2008. There is an indication from Congress the incentives will be extended but it is not assured the incentives will be extended and they certainly could change.

Figure 14 – Petroleum Government Incentives

- ✓ Tax subsidies ($9.1 to $17.8 billion)
- ✓ Program subsidies ($38 to $114.6 billion)
- ✓ Protection subsidies ($80 to $130 billion)
- ✓ Environmental, Health and Social Costs ($232 to $943 billion)
- ✓ Other External Costs ($191 to $475 billion)

$558.7 Billion to $1.69 Trillion Per Year

Source: International Center for Technology Assessment, 2004

The Energy Act of 2005, which became Public Law 109-58 on August 8, 2005, included, among other things, a federal excise tax credit and a small agri-biodiesel producers tax credit. The federal excise tax credit equates to one cent per percent of biodiesel in a fuel blend made from virgin oils and animal fats, and one-half penny per percent for recycled oils. This one-dollar per gallon tax credit for biodiesel made from virgin oil is clearly the key factor in bringing commercial biodiesel plants on-line today. The small agri-biodiesel producers tax credit establishes a 10-cent per gallon tax credit for up to 15 million gallons of production of annual production. Agri-biodiesel means biodiesel derived for virgin oils and animal fats. The IRS issued a guidance document on August 1, 2005, Notice 2005-62, which provides guidance on how the law will be applied. A key provision of the IRS requirements is that producers must certify the fuel meets ASTM standards. Form 8864 is used to file for the credits and both are effective until the end of 2008.

The State of Idaho also has an excise tax credit for blends of biodiesel up to 10 percent (Idaho Statutes, Title 63, Chapter 24). Any portion above a 10 percent blend must pay the existing tax rate. The credit amounts to 10 percent of the state fuel tax, or 2.5 cents per gallon, for a 10% biodiesel blend with diesel (B10) and above. For instance, a blend of 50 percent biodiesel and 50 percent diesel still only gets the 2.5 cents per gallon credit. Since it can be expected that mileage using 100 percent biodiesel is about 8 percent lower than diesel, the net effect is that as the biodiesel blend sold at the pump increases from 10 to 100 percent, this tax advantages essentially disappears. This credit is paid to the fuel distributor.

In addition to biodiesel, the plant will produce glycerin and, if the feedstock is from seed, meal. The assumptions for biodiesel and byproduct prices/revenues are shown in Table 17. Biodiesel retailers in Idaho are generally setting the pump price of biodiesel to be competitive with diesel. Estimating the future price of diesel is subjective. Figure 16 shows the national average price of diesel from 2004 through October 2006. The price of diesel in the Magic Valley is generally higher than the national average. For this evaluation the pump price of diesel was assumed to be $2.90 per gallon. With the road taxes and retailer/distributor profit this equates to selling biodiesel from the production plant to the retailer/distributor for about $2.38 per gallon, or about $0.52 per gallon less.

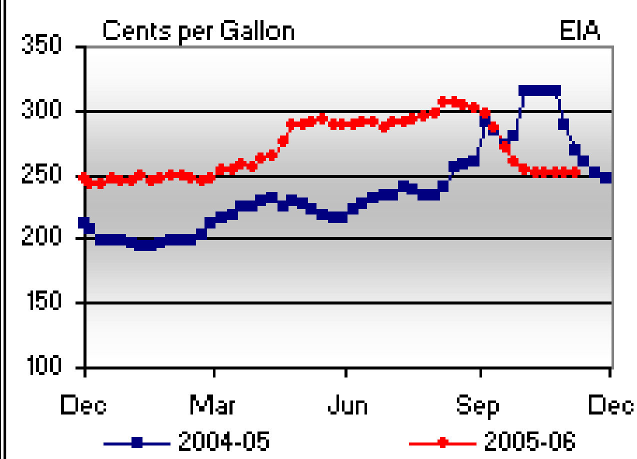


Figure 15 – U.S. On-Highway Diesel Fuel Prices
Source: Energy Information Administration, 2006

Table 17 - Biodiesel & Byproduct Price/Revenue Assumptions

Products	Application	Price	Comments
Biodiesel	Pump Price	$2.90/gal	Estimate
	Retailer/Dist. Profit	$0.05/gal	Estimate
	Federal Tax	$0.244/gal	
	State Tax	$0.225/gal	25¢ minus 2.5¢/gallon
	Fed. Excise Tax Credit	$1.00/gal	Virgin Oil& Tallow
	Fed. Excise Tax Credit	$0.50/gal	Used Oil
	*Fed. Small Agri-Tax Credit	$0.10/gal	Up to 15-million gal/yr
Glycerin	Heating Value	$0.21/lb	See pages 25-26
Meal	Cattle Feed	$125/ton	See pages 26-27

* Not available for biodiesel from used oil (yellow grease).

The costs, income streams and profit/loss for different sized mixed feedstock plants, based on the expense and revenue assumptions outlined previously, are shown in Table 18 and 19. Table 18 shows the costs, income streams and profit for a yellow grease and tallow plant based on the amount of those oils estimated to be available in the study area. Table 18 also a shows the results for plant using soy oil railed into the area and a locally grown crop. The various soy oil plant capacities are to compare results with the yellow grease and tallow plant, shown in Table 18, and the estimated range of available oil if the facility were using locally grown seed crops. Table 19 shows the results for the estimated range of available locally grown seed crops.

Table 18 – Yellow Grease/Tallow, Shipped Oil, and Local Crop Feedstock Expense, Income & Profit

FEEDSTOCK	Yellow Grease & Tallow*	----Shipped Soy Oil ----		Local Crop 38,083 Acres 2,500 lb/Acre
PLANT CAPACITY	**4.6 Million Gallon**	**4.6 Million Gallon**	**25.8 Million Gallon**	**4.6 Million Gallon**
Expenses	$9,112,510	$13,027,865	$70,188,565	$18,934,590
Cost/Gallon	$1.99	$2.85	$2.72	$4.14
Income	Based on a Biodiesel Pump Price $2.90 per Gallon			
Biodiesel Sales (@$2.381/Gal)	10,881,170	10,881,170	61,406.942	10,881,170
Fed. Tax Credits	4,745,000	5,027,000	27,290,400	5,027,000
Income/Gallon	$1.425	$0.63	$0.718	-$0.662
Meal Sales	0	0	0	1,428,125
Glycerol Sales	1,055,670	1,055,670	5,957,580	1,055,670
Total Income	16,681,840	16,963,840	94,654,925	18,391,965
Profit	$7,569,330	$3,935,973	$24,466,360	-$542,630
Profit/Gallon	$1.66	$0.86	$0.95	-$0.12

* 470,000 gallons of used oil and 4,100,000 gallons of tallow

Table 19 – Locally Grown Seed Crop Feedstock Expense, Income & Profit

FEEDSTOCK	---------- LOCALLY GROWN SEED CROP ----------			
	107,460 Acres		214,917 Acres	
	1,500 lb/Acre	2,500 lb/Acre	1,500 lb/Acre	2,500 lb/Acre
PLANT CAPACITY	**7.7 Million Gallon**	**12.9 Million Gallon**	**15.5 Million Gallon**	**25.8 Million Gallon**
Expenses	$31,486,330	$52,049,170	$62,972,655	$103,522,660
Cost/Gallon	$4.30	$4.04	$4.24	$4.01
Income	Based on a Biodiesel Pump Price $2.90 per Gallon			
Biodiesel Sales (@$2.381/Gal)	18,422,085	30,703,470	36,844,165	61,406,940
Fed. Tax Credits	8,510,830	14,184,720	16,974,240	27,290,400
Income/Gallon	-$0.824	-$0.555	-$0.76	-$0.575
Meal Sales	2,417,850	4,029,750	4,835,700	8,059,500
Glycerol Sales	1,787,275	2,978,790	3,574,550	5,957,580
Total Income	31,138,040	51,896,730	62,228,655	102,714,425
Profit	-$2,166,995	-$152,,440	-$3,352,205	-$808,230
Profit/Gallon	-$0.28	-$0.01	-$0.22	-$0.03

It should be noted that the results of Tables 18 and 19 assume full use and simplification of the federal excise tax credits and the state tax reduction. Since the federal credit is paid to the blender commercial biodiesel plants may sell 100 percent biodiesel if the retailer/distributor is taking the credit, or a biodiesel-diesel blend if the biodiesel production plant is taking the credit. It is clearly the advantage for the retailer/distributor to take the one-dollar per gallon tax credit since they have a tax liability. In either case the biodiesel plants developers should position themselves to take as much of the tax incentives as possible and the biodiesel must meet ASTM specifications. The evaluation also assumes the full 10 percent reduction in state tax. This may not be correct if biodiesel blends above 10 percent are sold.

Table 20 shows a sensitivity analysis for processing cost and net profit or loss per gallon and revenue per area as a function of seed cost per pound. For the assumptions used in this analysis, the cost for oil alone is $3.44 per gallon. From the sensitivity analysis it can be seen that the cost of the seed crop would need to be about $0.09 per pound before the plant is profitable. This one-cent difference in the cost of seed or seed processing changes the cost of the biodiesel by about $0.21. Table 21 shows the costs, income streams and profit/loss for a plant size that maybe considered for development assuming the seed price is $0.09 per pound. Potential plant developers should develop a spreadsheet in order to evaluate different assumptions for the plant assessment. The University of Idaho has developed a biodiesel production evaluation spreadsheet and it is available at www.biodieseleducation.org

Table 20 – Seed Price & Yield Sensitivity Analysis

Seed Cost Per Pound	Total Cost Per Gallon	Profit or Loss Per Gallon	------ Revenue Per Acre ------ 1,000 lb/Acre	1,500 lb/Acre	2,000 lb/Acre	2,500 lb/Acre	3,000 lb/Acre
$0.08	$3.63	$0.395	$80	$120	$160	$200	$240
$0.09	$3.84	$0.186	$90	$135	$180	$225	$270
$0.10	$4.05	-$0.022	$100	$150	$200	$250	$300

Table 21 – 12 Million Gallon Per Year Plant with Farmer Paid $225/Acre and 2,500 lb/Acre Yield

Feedstock	100,000 Acres of Oil Seed
Expenses	$45,969,155
Cost/Gallon	$3.84
Income	
Biodiesel Sales (@$2.381/Gal)	$28,572,000
Fed. Tax Credits	$13,200,000
Income/Gallon	-$0.35
Meal Sales	$3,750,000
Glycerol Sales	$2,772,000
Total Income	$48,294,000
Profit	$2,324,845
Profit/Gallon	$0.19

VII. PLANT SITE SELECTION, PERMITS & REGISTRATIONS

Site Considerations

Zoning and building impediments, transportation access, land cost, feedstock and market proximity, utility, wastewater treatment, and water availability are all important issues to consider in locating a biodiesel plant. The purchase or long-term lease of existing buildings may reduce costs in both time and money and may be preferable in all but the largest plants. Zoning permits, discussed in detail below, would be for commercial or light industry. Good road and, likely, rail access is a key factor for selecting a site. Interstate 84 dissects the study area from east to west and there is a good network of highways adjacent to rail lines. Rail access may not be necessary for plants less than 5, perhaps even 10 million gallons per year but limit feedstock flexibility and markets outside of the local area. Union Pacific Railroad runs through southern Idaho and Eastern Idaho Railroad runs within the study area as shown in Figure 14. It might also be possible for the Eastern Idaho Railroad to help upgrade a rail siding or spur.

The electrical demands for a biodiesel facility are approximately 0.1 kW per gallon of production or about 876,000 kWh per year per million gallons of annual production. All of the study area is served by Idaho Power Company. Current electrical rate for Idaho Power small commercial customers is 7-8-cent per kWh or \$60,000 to \$70,000 per year per million-gallon annual production. The service needs to be 3-phase at 480 volts and Idaho Power should be consulted for locations with adequate service. Intermountain Gas serves the study area where natural gas service is available.

Wastewater from the facility will likely need to be treated at the nearest water treatment facility. Much of the study area is under a moratorium for new water rights and the facility will likely need to be connected to the local water system. Proximity to feedstocks, markets, livestock operations, labor force, medical facilities, and airports may also influence site selection.

Local, State and Federal Permits

Permitting can be one of the biggest obstacles to the development of any industrial plant. In Idaho the permitting required for developing a biodiesel production facility should not be a formidable task. It should also not be considered trivial. Several of the most complex regulations are intended to avoid needing a permit by minimizing health, safety and environmental risks. Since laws and regulations are continually changing, the following discussion should be considered preparatory with standard circumstances normally associated with building a biodiesel production facility.

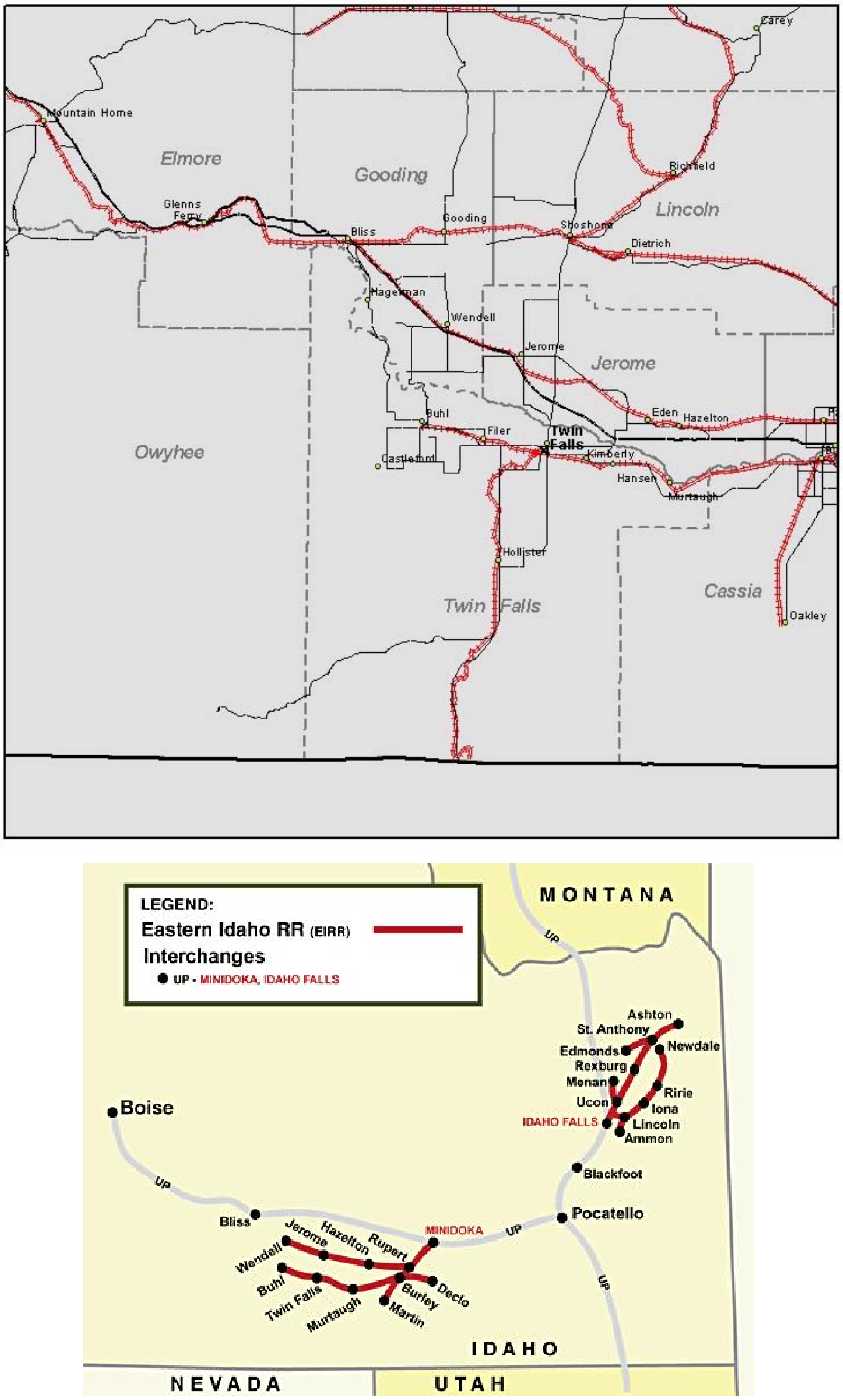


Figure 16 – Eastern Idaho Railroad and Union Pacific Operate Within the Study Area

Zoning and Building Permits

In Idaho, the local zoning permit is the primary regulatory permit needed to construct a biodiesel production facility. It can also evolve into a monstrous exercise in time, money and frustration. Idaho Code 67-6511 gives the county or municipality legal authority to control the use of property and physical configuration of development upon tracts of land within their jurisdiction. The zoning process must be based on comprehensive plans and are enacted for the protection of public health, safety and welfare. The zoning and building permits requirements vary widely within the state and may be the deciding factors in selecting a site.

In most cases, the project development team should include an architectural or engineering firm familiar with obtaining zoning and building permits in the area. This will save time and money. Potential developers will first need to meet with the local Fire Marshal, transportation authority and planning and zoning officer and be prepared to provide and/or discuss information listed in the box shown below.

Normally this information is refined during the zoning process to conform to the local requirements. Depending upon the jurisdiction there may be various fees, prior approvals by various agencies like the Fire Marshal and local highway authority, and a hearing before the planning and zoning authority. Once there is zoning compliance and approval, potential developers must also obtain building permits from the local planning authority. Building Codes are collections of regulations that pertain to specific subjects such as designing, constructing or remodeling of buildings. City and County Building Codes are adopted locally by ordinance but must be recognized by the Idaho Division of Building Safety. Adherence with the National Fire Code, which is administered by the local Fire Marshal, will likely influence the design of the facility.

Information to Develop for Planning & Zoning

- Legal description and Assessor Account Number
- Current zoning information and occupancy classification
- Building plans and construction type(s)
  - Electrical, mechanical and plumbing plans
  - Facility layout and floor areas
- Plot and Site plans
  - Topography, property lines and distances
  - Building(s) and transportation layout
  - Sewer, water line, electrical service, and fire hydrant locations
  - Landscape plan
- Operation plans, including:
  - Process, quantities of materials, hazardous materials and MSDS sheets
  - Transportation plan
  - Fire plan with access and turn around
  - Water, sewage and solid waste plans
  - Drainage, erosion and sediment control plans
- Building and Fire Code evaluation
- When in a flood plain, an Elevation Certificate

Storage Tanks

Storage tanks used for commercial biodiesel production facilities are subject to federal regulations. In Idaho, the EPA enforces storage tank regulations which are divided into above ground tanks and underground tanks. Above ground storage tanks are regulated by the EPA in accordance with the Clean Water Act, as amended by the Oil Pollution Act. The text of the regulation is found at 40 CFR part 112. This regulation establishes requirements for facilities to prevent oil spills from reaching surface waters. The rule applies to facilities that have an aggregate storage capacity greater than 1,320 gallons or a completely buried storage capacity greater than 42,000 gallons; and could reasonably be expected to discharge oil in quantities that may be harmful into surface waters. The regulations apply specifically to a facility's storage capacity, regardless of whether the tank(s) is completely filled.

The EPA does not permit or register regulated facilities but has the authority to penalize owners if they are not complying with the regulations. Regulated facilities are required to have a fully prepared and implemented Spill Prevention, Control, and Countermeasure, or SPCC Plan (SPCC rule) and a Facility Response Plan (FRP). A licensed professional engineer must certify the SPCC Plan. The SPCC Plan is required to address the facility's design, operation, and maintenance procedures established to prevent spills from occurring, as well as countermeasures to control, contain, clean up, and mitigate the effects of an oil spill that could affect navigable waters. In addition, facility owners or operators must conduct employee training on the contents of the SPCC Plan. An FRP is a plan for responding, to the maximum extent practicable, to a worst case discharge of oil and to a substantial threat of such a discharge. The Plan also includes responding to small and medium discharges as appropriate. Administration of the regulations is done through the Boise office and further information can be obtained at www.epa.gov/oilspill.

Underground storage tanks (UST), or tanks that are at least 10% buried, that store petroleum products or other hazardous liquids must be registered with the EPA, using EPA Form 7530-1, and meet leak detection requirements. Local EPA Emergency Response and Hazardous Waste personnel conduct inspections of underground storage tank facilities. The DEQ Waste Management and Remediation Division offers technical assistance but it does not have storage tank enforcement authority. DEQ does have the authority to require investigations and cleanups of releases from leaking underground storage tanks (LUST). Federal regulations of UST can be found in 40 CFR Parts 280 and 281.

Federal law requires owners to carry pollution liability coverage for regulated USTs to demonstrate they have the resources to pay for cleanup and compensatory costs. Idaho's Petroleum Storage Tank Fund (PSTF) operates as a nonprofit insurance company and is responsible for administering the Idaho Petroleum Clean Water Trust Fund. The petroleum liability insurance policies issued to owners and operators of regulated USTs through the PSTF satisfies the federal financial responsibility requirements. The PSTF also provides insurance coverage to owners of all eligible unregulated above ground petroleum storage tanks. Further information on the Idaho State Insurance Fund can be found at www.idahosif.org.

Hazardous Materials Permitting

A biodiesel production facility will involve the handling of hazardous material such as methanol and strong bases. A commercial production facility will have a quality control laboratory staffed by personnel trained in laboratory practices and responsible for assuring compliance with various laws and regulations related to hazardous materials. The provisions of OSHA require, among other things, hazardous materials training, Material Safety Data Sheets (MSDS) for all chemicals used in the facility, and numerous employee safety requirements.

The Resource Conservation and Recovery Act (RCRA) is the federal law regulating the generation, handling, storage, treatment, and disposal of hazardous wastes. In Idaho, DEQ's Waste Management and Remediation Division administers the RCRA regulations. Under these regulations businesses are responsible for determining whether any wastes generated are hazardous and the amount. With some exceptions, facilities that treat, store or dispose of hazardous wastes are subject to the permitting process. The degree to which a generator of hazardous waste is regulated depends on how much waste is produced every calendar month.

In general, a biodiesel production facility should not be a hazardous waste generator. A facility that generates a small amount of hazardous waste may fall into the least regulated category of hazardous waste generator called the Conditionally Exempt Small Quantity Generator (CESQG). CESQGs generate less than 100 kg (220 pounds) of hazardous waste per month, or less than 1 kg (2.2 pounds) of acutely hazardous waste, and are subject to a limited, less stringent set of generator waste management standards. CESQGs are required to keep track of the amount of hazardous wastes generated and stored on-site each month, have on-site documentation that the facility is within the limits for this classification and properly dispose of the wastes. The facility may also wish to obtain an EPA Identification Number to track quantities, types, and movement of hazardous wastes the facility generates.

Another key issue under RCRA is the designation of "waste." Raw materials in storage are not waste and material recovered as part of the process are not waste unless so designated. Recovered co-products are not waste if they are to be used elsewhere in processing or legitimately sold to another entity. Materials cannot be stockpiled and must have a "reasonable expectation" of use within the facility within specified time periods. RCRA provides a strong incentive to operate in such a way as to avoid being required to have a permit. The permitting process can take years to complete due to the technical standards that must be met, and requires considerable reporting once the permits are issued.

Operation of a biodiesel production facility will require submittal of "Tier II Forms" with a listing of potentially hazardous chemicals stored on-site under the Emergency Planning and Community Right to Know Act (EPCRA). EPCRA, or Right-to-Know, provides community access to information about chemical hazards and facilitates emergency response plans by state and local governments. Forms are submitted annually to the Idaho Department of Homeland Security (also identified as the State Emergency

Response Commission or SERC), the Local Emergency Planning Committee (LEPC) and the Fire Marshall. Tier II Forms require basic facility identification information, employee contact information for both emergencies and non-emergencies, and information about chemicals stored or used at the facility. Additional submittals are required if chemicals in excess of “threshold” amounts are used or stored. Complete information on Tier II reporting is available at www.bhs.idaho.gov.

Air Quality Permit(s)

In addition to the EPA Fuel Certification previously discussed, any business or industry (source) in Idaho that emits, or has the potential to emit, pollutants into the air are required to have an air pollution control permit. Transportation, handling and storage of agricultural oilseed feedstock are potential sources of particulate matter emissions. If the facility design includes combustion as the source of process heat, the facility may be required to install equipment to control gaseous and particulate matter emissions.

The Air Quality Division of the Idaho Department of Environmental Quality (DEQ) is the state agency delegated to issue air quality permits in Idaho. Development of a biodiesel production facility may require a Permit to Construct (PTC) or a Tier II Operating Permit. A PTC is required prior to construction or modification of stationary sources, such as buildings, structures, and other installations that emit, or may emit, pollutants into the air. A PTC is also required for certain portable equipment such as generators. PTC applicants are required to submit the following information:

- A complete description of the proposed process from raw material feed to final product output, including operating design capacity, hours of operation, and feed material characteristics.
- Manufacturers' guarantees for stated control efficiencies of all control equipment.
- Emission estimates for all regulated air pollutants with supporting calculations, assumptions, or manufacturer guarantees for emission control devices.
- A description of potential fugitive emissions.
- A narrative description of the facility and the process from feed material in to final product output.
- A process flow diagram.
- A scaled plot plan clearly showing property boundaries, building, and stack locations.
- Stack height, diameter, orientation (e.g., vertical or horizontal), gas flow rate, and temperature for each emission point.
- Any other information necessary to determine which regulations affect the stationary source and any information needed to determine if the source will continuously comply with all applicable regulations (including federal).

An application fee of $1,000 is required with any PTC application. A PTC processing fee is also required and is dependant upon the quantity of permitted emissions.

DEQ may also require an operating permit. A Tier II Operating Permit is required for existing buildings, structures and installations that emit or may emit small amounts of pollutants. For example, DEQ might take this action as part of a State Implementation Plan designed to prevent further deterioration of air quality and to bring an area of the state back into compliance with the National Ambient Air Quality Standards. Tier II permits also may be issued to authorize an alternative emission limit for a particular emissions unit or units within a facility. All information submitted to DEQ must be certified by a responsible official to be true, accurate, and complete. Further air quality permit information and applications are available at the DEQ offices and at their website, www.deq.idaho.gov.

Miscellaneous

Compliance with other local, state, and federal regulations may be necessary depending on the facility size, specific location, process and specific circumstances. The Idaho Small Business Development Center offers free assistance to small businesses on environmental issues, regulations and OSHA compliance obligations through its Environmental Solutions program. Help is available by phone, email, or appointment to answer questions, solve problems, and provide guidance on a one-on-one basis. Further information can be found www.idahosbdc.org.

Registration, License and Certification

All biodiesel businesses, small and large, need to be aware of the fuel distributor registration and licensing requirements and certification with the Environmental Protection Agency.

Fuel Distributor Registration and License

A blender, producer or importer of biodiesel must be registered with the IRS using Form 637. To become registered is a time consuming process and plans should be made accordingly so that production can commence when the construction is finished. Otherwise the plant will sit idle until the registration is approved. Form 720 is the quarterly excise tax return, which is used to report and pay federal excise tax.

Idaho Code Sections 63-2433 and 63-2443 make it unlawful to act as a fuel distributor without a valid fuel distributor license. The Idaho State Tax Commission issues fuel distributor licenses. License application forms and bonding requirements are available at the Tax Commission office or on the internet at: www.tax.idaho.gov. A fuel distributor license requires a bond equal to the amount of fuels tax that would be due to the state for a 60-day period. The minimum bond amount is $1,000 and the maximum bond amount is $200,000. A fuel distributor remits fuel taxes to the state monthly on a Form 1450. If an individual produces biodiesel for personal use only, the individual is required to file a Form 75 and pay the Idaho fuels tax due on the biodiesel.

Idaho Code Section 63-2425 makes it unlawful to operate registered motor vehicles on Idaho's public highways with fuel that has not been taxed. Dyed diesel fuel that is used to operate stationary engines and unlicensed farm equipment is exempt from the Idaho fuels tax. The use of dyed diesel fuel in most licensed vehicles and in unlicensed vehicles equipped for highway use is prohibited by federal and state law. This includes registered vehicles that never leave private property or vehicles that are operated entirely on job sites or Forest Service roads. Even the occasional use of dyed fuel will contaminate the vehicle's fuel tank and is against the law. It should also be noted biodiesel is subject to the federal excise taxes and federal law prohibits the hand-dyeing of biodiesel to make the fuel nontaxable fuel.

EPA Certification

The Clean Air Act (CCA) authorized Environmental Protection Agency (EPA) to establish National Ambient Quality Standards to limit air pollutants. EPA subsequently promulgated strict rules for the amount of carbon monoxide, unburned hydrocarbons, oxides of nitrogen, and particulate matter that an engine is allowed to emit. Under sections 211(b) and 211(e) of CCA, EPA requires producers of fuels and fuel additives intended for use in motor vehicles to register their fuel. Fuels were then broken into baseline fuels, non-baseline fuels and atypical fuels. Diesel is the baseline fuel. Non-baseline is fuel that contains higher oxygen than diesel and is not a fossil fuel. Atypical is all other fuels.

Although emissions from biodiesel are well established, the EPA ultimately determined, with reasoning that is not clear, that biodiesel is an atypical fuel and is therefore subject to the strictest requirements of registration. Under these requirements biodiesel producers can either conduct emissions studies that will cost millions of dollars, or participant in a group of manufacturers of the same or similar fuel. The National Biodiesel Board (NBB) is currently the only organization that has submitted emission testing results and subsequently received EPA certification acting as a manufacturers' group for biodiesel. The National Biodiesel Board is given the authority to recover the costs of the testing and submission of the application from the manufacturers of biodiesel the National Biodiesel Board has implemented a biodiesel manufacturers registration process. To become a member of the National Biodiesel Board, interested parties should contact them at 1-888-BIODIESEL or at NBB's website www.NBB.org.

VIII. CONCLUSIONS & RECOMENDATIONS

The Magic Valley as defined in this report is the eight county area of south-central Idaho with a population of approximately 170,600 and 1.37 million acres of cropland. The major findings of this study as related to production and marketing of biodiesel in the study area are listed below and recommendations follow.

Conclusions

1. This analysis shows that local feedstocks, resources, and markets are available within the study area to support a biodiesel industry. While the study includes 0.5 to 26 million-gallon scenarios, the greatest potential exists in the 5 to 15 million-gallon range. There is potential for importing feedstock, initially, and marketing outside. Marketing outside the study area was not considered.

2. The estimated available feedstock from used oils included 95,000 gallons of yellow grease, 4.1 million gallons from tallow, and 375,000 gallons from food processing.

3. In order for farmer to successfully grow seed crops in the study area the crop must fit in with the rotation and provide a reasonable rate of return. Farmers growing seed crops would likely be replacing a small grain crop. For this study evaluations were based on 10-20 percent of the harvested cropland in the study area. This is about 30-60 percent of the small grains that are grown.

4. Oil available from oil seed crops is highly dependent on crop rotation strategies and estimates of potential yield. Adequate information on oil seed production under irrigation is lacking. The estimated yields for this study ranged from 1,500 to 2,500 pounds per acre. This results in plant capacity range of 7.7 million gallons from 107,460 acres at 1,500 pounds per acre yield, and 25.8 million gallons from 214,920 acres at 2,500 pounds per acre.

5. Potential oil seed crops other than brassicas include safflower and sunflower. Sunflower may be too susceptible to bird damage, which are plentiful in the study area. Safflower may hold considerable promise since it only needs water early in the irrigation season and many southern Idaho farmers have recently been confronted with water shortage problems. Safflower grown in the Pacific Northwest has also exhibited high yields with high oil content. There may also be other crops, like Camelina, that could be adapted but agronomic information has not been developed. Most of the information is from individual growers or from other regions.

6. Potential local market for biodiesel is about 12 million gallons at a 20 percent biodiesel-diesel blend. A more realistic estimate may be 3 million gallons, which is equivalent to a 5 percent blend.

7. For each million gallons of biodiesel produced from oil seeds there would be approximately 6,700 tons of mill for about 7,300 dairy cows. There are more than sufficient cows in the study area to utilize the meal, however, the market would need to be developed.

8. For each million gallons of biodiesel, a market must also be found for 750,000 pounds of glycerol.

9. The estimated capital cost of a biodiesel plant is dependent on size and is approximately $2 per gallon plant size for a 0.5 million-gallon plant down to about $1 per gallon of plant size for a 20 million gallon plant. This does not include a crushing unit for the oilseeds or facilities for glycerin purification.

10. Profit from a biodiesel plant is feedstock dependent with potential profit from yellow grease highest followed by tallow, railed in virgin oil and locally grown virgin oil. It is assumed a large plant would utilize a mix of these oils to meet plant-operating requirements.

11. Business plans must include provisions for required local, state, and federal permits and taxes.

12. Biodiesel producers should become familiar with state and federal biodiesel incentives, which significantly impact profitability. The federal tax incentives are not guaranteed for the long term, therefore, the impact must be carefully considered when planning a biodiesel facility.

13. The most desirable location for a biodiesel plant is dependent on size. When selecting a site carefully consider the available utilities, transportation, environmental impacts and potential for expansion. There is significant advantage for larger plants to be on a rail spur and several potential sites exist in the study area.

Recommendations

1. This study provides an overview of the issues related to developing plans for a biodiesel plant. Every plant must develop a detailed business and process plan.

2. By far the biggest issues regarding the feasibility of a commercial biodiesel plant in Idaho are the cost and availability of the feedstock. The Magic Valley can only support about a 5-million gallon per year plant with yellow grease and tallow. Railing in virgin oil is currently attractive financially but it is unlikely to remain so with the large number of biodiesel plants being constructed in the nation. Growing a local seed crop could assure adequate supply of oil in Magic Valley if their return on investment is comparable to or higher than small grains.

3. Those planning to use oilseed crops grown in the study area need to develop agronomic data related to the specific crops selected.

4. While the data presented suggest an adequate market for biodiesel, the actual market has not been fully assessed. Developers are making a big mistake if they just assume that if biodiesel is produced it can be sold for a reasonable price. Biodiesel is in direct competition petroleum industry, which controls the market. In Idaho the petroleum oligopoly largely dictates what is in the fuel sold at the pump and it is not generally in their best interest if it is a product that comes from a source other than their own. Without state legislation the biodiesel diesel market in Idaho will likely be extremely limited.

5. State and federal incentives are currently favorable to biodiesel, however, the possibility that they may sunset may limit the ability of biodiesel producers to obtain long term funding. Future legislation should have provisions to encourage investments in these enterprises for the long term. The biodiesel industry competes directly with the petroleum oligopoly, which has and is likely to continue to receive considerable governmental incentives. Without corresponding incentives the biodiesel industry is not competitive with petroleum diesel. Biodiesel plant developers must also be in a position to take full or nearly full advantage of the incentives.

6. Each biodiesel producer must make provisions for quality control and required testing to assure that the fuel meets ASTM specifications. This likely requires an analytical lab as part of the plant although contracting with an existing laboratory for limited may be possible.

7. Those planning to use oilseed crops grown in the study area need to develop a seed processing facility.

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